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2011

Program Evaluation of Developmental Math Instruction at the Community College Level

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Program Evaluation of Developmental Math Instruction at the Community College Level

By
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A Dissertation Submitted to the
Gardner-Webb School of Education
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Education

Gardner-Webb University
2011

Approval Page

This dissertation was submitted by John M. McHugh under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

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Acknowledgments

I wish to thank my wife Ruth for her patience and understanding. I would also like to thank the staff at the Learning Center who helped with the testing, Dr. Rex Clay for his feedback, and Audrey Sherrill for her assistance. A special thank you to Allison Ames, a doctoral student in mathematics, who helped with the data analysis. I would also like to thank Benjamin Humphries for his help with the pretests and posttests. Unfortunately, Benjamin did not live to see the final product.

I wish to thank Dr. Sydney Brown for her patience, her phone calls, her emails, and her encouragement when the light grew dim. I would also like to thank the other committee members, Dr. David Shellman and Dr. Jane King, who kept me going through the tough times with their encouragement and kind words.

Abstract

Program Evaluation of Developmental Math Instruction at the Community College Level. McHugh, John, 2011: Dissertation, Gardner-Webb University, Program Evaluation/Developmental Math/CIPP Model/Community College/Remedial Math/ Developmental Math Curriculum/Developmental Math Instruction/Developmental Math Professional Development

This program evaluation case study examined the academic effectiveness of a developmental math program in the southeastern United States. The CIPP Evaluation Model (Fitzpatrick, Sanders, & Worthen, 2004) was used as the framework for this program evaluation. The research questions used to guide the research were (1) what are the conditions leading to the necessity of a developmental mathematics program at the college level; (2) what other attempts have been made to solve the problem; (3) how does the implementation of the developmental math program at this college align with recommendations for appropriate instruction of developmental math students; (4) how is the developmental math program at the college being implemented; and (5) how effective is the developmental math program at the college.

The data collection consisted of qualitative and quantitative methods including interviews, surveys, a pretest and posttest of math achievement, and documentation review. The information from the surveys and documentation review was coded and then entered into an Excel spreadsheet and analyzed for frequency of occurrence by code. The interviews were recorded, transcribed, and then coded. This data, along with the data from pretests and posttests, were then entered into SPSS software for analysis. Several *t*-tests and ANOVA tests were conducted on the data. The above results are displayed in tabular form and discussed in narrative form.

Based on the results of the program evaluation, it appears as if this developmental math program was doing what it was designed to do. The researcher recommended that professional development on working with underprepared students is needed. Also, further research is needed with former developmental math students in order to determine their concerns. Further research is also recommended for the different age groups to determine why there are statistically significant differences in the algebra scores.

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Chapter 1: Introduction

Introduction

A recent analysis of the data of those high school juniors and seniors who took the American College Testing (ACT) college entrance exam in 2005 found that about 50% were not ready for college-level math (ACT, 2006). According to the National Center for Education Statistics (NCES, 2000), 35% of entering freshman in the United States take a noncredit bearing remedial course in mathematics at public 2-year colleges. Of those students who take remedial mathematics courses, 27% will earn a bachelor's degree. By comparison, 58% of students who take no remedial courses will earn a bachelor's degree (Adelman, 2004).

Despite these gloomy statistics, 81% of America's high school students expect to attend college (High School Survey of Student Engagement, 2005). This is a wise and admirable goal, since 80% of the fastest-growing jobs in the United States require at least some postsecondary education, according to the U.S. Department of Education (Hecker, 2005).

Many new college students arrive on campus lacking the necessary preparation to successfully pursue postsecondary education. This problem of underpreparation manifests itself in high attrition rates among students enrolling in colleges, especially among those from disadvantaged backgrounds (Venezia, Kirst, & Antonio, 2003). Remedial – also known as developmental – education is offered in 80% of 4-year colleges and 98% of 2-year colleges across the U.S. (NCES, 2003).

At the state level, a study of 1997-1998 North Carolina public high school seniors who enrolled at a UNC institution in the fall of 1998 found that almost 43% of students who met the minimum requirements of math courses needed to graduate high school were placed in a remedial math class at the college level (College Foundation of North Carolina, 2005). This is in keeping with the national average. However, the 3-year graduation rate for students earning an associate's degree in 2007 in North Carolina was about 21.5%, which was below the national average of 27.5% (The National Center for Higher Education Management Systems, 2009). These percentages come from the data that are submitted by the local community colleges to the state. Therefore, data from the local community colleges should closely resemble the data at the state level.

Of the approximately 5,600 curriculum students who enrolled in a curriculum class at the college serving as the focus of this study in the fall of 2008, 1,186 (approximately 21%), of them took at least one remedial math class. This does not include those students who were eligible to take a remedial math class and did not take one in the fall of 2008. In order to avoid confusion, this college will be referred to as College A in this study. The term *college system* refers to the collection of all community colleges in the state.

For as long as College A has been in existence, there have been students who have struggled with college-level math classes. The college has attempted to offer various methods to help these students, such as study sessions, summer remedial courses, and tutoring. Over the years, these attempts at remediation have grown into a separate department offering remediation in English and reading, as well as in math. Although the developmental education department has been in existence since 1992, there has never been a program evaluation carried out on any part of it.

The researcher is the current chairperson of the developmental education department at the college. Prior to this, the researcher taught mathematics in the public school system and also held the position at Central Office as the instructional specialist for secondary mathematics. While working in the public school system, the researcher taught as a part-time college instructor for approximately 4 years before taking a full-time position with the college in 2005. The researcher taught developmental math classes and college-level math classes as well as having served as an internal evaluator of the developmental math program. As such, the researcher conducted all the interviews and surveys included in this study. The researcher also analyzed the data from the pretests and posttests included in this study and presented the conclusions and findings.

This program evaluation uses both the terms *remedial* and *developmental* throughout. In order for the reader to understand the usage of these terms, a definition of each one is given.

Definition of Terms

Historically, the terms remedial and developmental have been used interchangeably to label preparatory programs, or courses of study, that have as their central purpose the development of basic skills to such levels that students can profit from instruction in college-level courses (Rouche & Rouche, 1999). In practice, however, many educators make a distinction between the two terms, using developmental to describe instruction that prepares students for specific college courses or programs, and remedial to describe instruction that has, or should have, been provided in the past (Arendale, 2005). In this study, when a particular source is cited, the terminology used in that particular source was the terminology that was used. Moreover, the term remedial is often considered to have a negative connotation. This paper primarily discusses developmental math classes. To simplify the exposition of, and to avoid the overuse of either term, the words developmental and remedial are used interchangeably. No positive or negative connotation is intended.

Over the years, developmental/remedial education has evolved from unrelated efforts to improve upon individual skill deficiencies to the more complex and organized efforts to develop the cognitive and affective talents that describe the whole student. In the 1980s, the National Association of Developmental Education (NADE) not only shifted its focus from using remedial to developmental as its preferred descriptor for any and all below college-level courses, but expanded developmental education to include all forms of learning assistance, including tutoring, mentoring, supplemental instruction, personal/career counseling, and academic advising. This shift in defining a remedial/developmental program as a group of reading, writing, and math courses to a larger, more inclusive group of courses and support services recognized the reality that student learning and the barriers to such learning were not limited to the classroom. In 1995, NADE expanded its definition of developmental education even further to include all postsecondary learners, even those in college-level courses, because almost all learners could develop and benefit from tutoring and other learning assistance programs. NADE's (2009) motto is to "help underprepared students prepare, prepared students advance, and advanced students excel" (p. 1). The term *developmental math* is the more commonly used term within the developmental education department at the college. Currently, the developmental math courses offered by the college examined in this study are MAT 060, MAT 070, and MAT 080 (see Appendices A, B, and C for the descriptions of these courses).

Background of the Study

The setting of the program evaluation is a community college in the southeastern United States. This is a community college that serves an average of approximately 5,000 curriculum students per semester and approximately 7,000 students per semester in its Continuing Education programs. The college is fully accredited by the Southern Association of Colleges and Schools, and is also a part of the North Carolina Community College system. The college is comprised of three campuses: the main campus and two other smaller campuses. The college is a commuter institution and does not have dormitories or housing for rent. The students come from a mixed socioeconomic background. In the spring of 2009, the enrollment in the curriculum classes (a total of 7,140 students) was split into 34% men and 66% women. The ethnicity was reported as 78% White, 15% Black/African American, 5% Hispanic, and the remaining 2% was split between the ethnicities of American Indian, Asian, mixed-race, and those who did not respond. The age groups reflected the fact that 51% were less than 25 years of age, 22% were between 26 and 35 years of age, and 27% were 36 years of age or older. The statistic on where the students came from reported that 70% of the students came from the county where the main campus is located, 18% from the adjoining county where the second of three campuses is located, and the remaining 12% were from somewhere other than these two counties. There are five full-time math instructors who teach developmental math classes. In addition, there are usually at least 10 part-time instructors who teach one or more developmental math classes depending upon the enrollment each semester. There are five full-time faculty and four part-time faculty who teach college-credit math classes at the college, depending on the enrollment and the number of math courses offered. The developmental math classes are limited to 25 students per class. All developmental math instructors use the same textbook, the same syllabus, and follow the same course competencies for each level of developmental math. Each student must pass the class with at least a C and also pass a common final exam that is given at the end of each semester in order to progress to the next level.

All students who are planning on attending the college are asked to take a placement test. The placement test is called the Computer-Adaptive Placement Assessment and Support System (COMPASS®) test and is a nationally recognized placement test. The COMPASS® test is an untimed, computerized test that helps the college place students into appropriate courses based on their level of skills. Students may use a calculator on the entire test. COMPASS® also offers tests in reading, writing, math, writing essay, and English as a Second Language (ESL). Students receive their COMPASS® test results immediately upon completion of testing. Students are either assigned to a developmental math class or to a college-level math class based on the results of this placement test (see Appendix D). Students may also be exempt from taking the placement test. To be exempt from taking the mathematics placement test, a student needs a score of 21 or higher on the ACT Mathematics, or a score of 520 or higher on the SAT Mathematics. This would automatically place a student in the MAT 121, 151, or 161/161A level, or any of the other college-level math classes. This would mean that the student would avoid having to take any developmental math classes at the college. As a side note, a student must have an SAT Critical Reading score of 500 or higher or an ACT English score of 21 or higher to place out of any reading or English remedial classes. Some students may have taken the Asset Test or Accuplacer Test at another institution before coming to the college. The scores from these tests are also used to place a student in the appropriate math class. The placement scores for the Asset Test and Accuplacer Test are also included in Appendix D. As part of this study, the math placement score for each student was used as the pretest and was referred to as the pretest throughout. The college had already collected these placement scores and stored them in the college computer system. The researcher had access to these placement scores and included them in the data analysis. Towards the end of the semester, the students retook the placement test again and this was referred to as the posttest.

The developmental math program is the curriculum program that was evaluated using the CIPP Evaluation of School Curriculum model created by Stufflebeam (2002). The program is delivered to all students who must take a developmental math class. The program in its current form was first described in the 1994-1996 college catalog, and arose out of the need to help students be better prepared to take college-level math classes. Donovan's (1974) study of successful programs for at-risk students found that those who evaluated their programs on a regular and systematic basis were more successful than those who did not. This finding was reaffirmed in Roueche and Snow's (1977) study of successful remedial programs. A later study by Boylan, Bonham, Claxton, and Bliss (1992) found that program evaluation was positively related to remedial courses and also better long-term retention rates of remedial students. A thorough search of the historical data and the information from the various interviews did not yield any indication that a program evaluation had ever been carried out on the developmental math program at this college.

The curriculum for the developmental math program is based on the competencies set forth by the North Carolina Community College System (NCCCS; see Appendices A, B, and C). The goal of the program is to prepare students to be successful in a college-credit bearing math class, so that there should be no difference in the performance of developmental students as compared to nondevelopmental students in their first college credit-bearing math class. Currently, there are only two methods of data comparison that are utilized when looking at the developmental math program at the state level and at the college level. The standards that are currently in place at the state and local level are that

75% of students in a developmental course must receive a passing grade for that course, and that 80% of developmental students must pass their first subsequent college-level course (NCCCS, 2009). These comparisons do not take into account that many students who take developmental math classes do not end up taking college-level math classes. Therefore, there is no way of knowing how well, or how poorly, the developmental math program worked for these particular students. Also, there is no available data to show the actual improvement in math ability of those students who start out in MAT 060 (Basic Mathematics) and eventually take MAT 161 (College Algebra). There is no breakdown of the data into the different subgroups in order to determine if the developmental math program is more beneficial to one subgroup than others. The current method of comparing developmental math students with nondevelopmental math students does not provide the data on whether those students who are under 25 years of age benefitted more from the program than those who are over 35 years of age, or whether those who are female benefitted more than those who are male. This study addresses these issues.

Program Description

The developmental math program consists of three levels of mathematics: MAT 060 Essential or Basic Math, MAT 070 Introductory Algebra, and MAT 080 Intermediate Algebra. These courses are sequential in nature. When a student takes the placement test, he/she receives a placement score. This score is then used to place the student in a particular math class as demonstrated by the chart in Appendix D. The student will either take one of the developmental math classes or a college-level math class. If a student places into MAT 060, that student must pass the course and the final exam in order to progress to the MAT 070 class. Then they must take and pass the course and final exam in MAT 070 in order to progress to MAT 080. If the student fails the course, then that student must repeat the course again. For MAT 060, the topics include the principles and applications of decimals, fractions, percents, ratios and proportions, order of operations, signed numbers, geometry, measurement, and elements of algebra and statistics. For MAT 070, the topics include signed numbers, exponents, order of operations, simplifying expressions, solving linear equations and inequalities, graphing, formulas, polynomials, factoring, and elements of geometry. For MAT 080, the topics include factoring, rational expressions, rational exponents, rational equations, radical equations, quadratic equations, systems of equations, inequalities, graphing, functions, variations, complex numbers, and elements of geometry. These remedial math classes do not count toward college credits. These competencies are consistent with NCCCS standards. In order for the students to progress from one level to the next, they must pass the class and the final exam.

Student progress in each developmental mathematics class is measured primarily by performance on tests, quizzes, and homework. It is up to each individual instructor to create his/her own tests and quizzes (except for the common final exams which are created by the department), and to determine how many points he/she will give for each assignment. Instructors also determine the number of tests given, the level and difficulty of each question, the number of questions, and how many points each question is worth. Essentially, this means that each instructor sets the standard for what constitutes a particular letter grade in each class. There is no common standard or grading policy within the department. Other than having a common final exam, the standard within the classroom is set by each instructor. A score of 70 or above is considered a passing score on all the coursework for all classes. A score of 70 or above is considered a passing score on the common final exams. It is up to each individual instructor as to how the overall grade will be assigned. Some instructors average the final exam grade in with the class grade while others do not. Some instructors drop the lowest grade on the coursework while others do not. When it comes to assigning the overall grade for each student, there is no one set policy on how to do this. It is left up to each individual instructor.

The college operates on the 10-point grading scale where an A is from a 90 up to and including a 100, a B is from an 80 up to and including an 89, a C is from a 70 up to and including a 79, and an F is a score from a 0 up to and including a 69. There is also a special grade of an IP (In Progress), which is only given to students in the Developmental Program. If a student does not pass the course, then that student may be given a grade of an IP. The IP does not affect the student's overall GPA, but the student will have to repeat the class again and meet all the requirements in order to progress to the next level. At the end of each semester, each student is required to take and pass a common final exam. In order to pass to the next level of mathematics, a student must pass the class with an overall average of 70 or better, and pass the final exam with a score of 70 or better. Failure to meet one or both of these requirements means that the student must repeat the course.

The developmental math courses at the college are offered in three ways – seated, hybrid, and online. The first way is the traditional method of classroom instruction. These classes are often referred to as *seated* when used in discussions involving the other types of classes.

Approximately 60% of these seated math classes are offered during the day and 40% are offered in the evening. A day class is any class that has a starting time before 5:30 p.m., and an evening class is any class that has a starting time of 5:30 p.m. or later, as described on the college website. The day classes typically meet 5 days per week, Monday through Friday, for 53 minutes each day. The evening classes meet 2 evenings per week on either a Monday and Wednesday or a Tuesday and Thursday. The evening classes currently start at 5:30 p.m. and last until 7:40 p.m., or they start at 7:45 p.m. and last until 9:55 p.m. The second way is through hybrid classes which are a combination of classroom instruction and online work. The students typically meet in the classroom 2 days a week, usually on a Monday and Wednesday, or on a Tuesday and Thursday, for 53 minutes. Currently the hybrid classes are offered as day classes. The rest of the instruction is provided online using the Internet. When the students meet in the classroom on those 2 days per week, it gives them an opportunity to ask questions or to ask for clarification on something directly from the instructor. It also gives the instructor the opportunity to provide direct instruction. The third method is through a completely online class. The students may attend the college for an orientation session at the beginning of the semester for an explanation of how the course is set up, where to find the assignments, and how to contact the instructor, etc. The students then must complete the online assignments. They may contact their instructor via email in order to get some assistance with the assignments at any time during the course. They may also come on campus to meet with the instructor during the instructor's office hours. Regardless of which method of instruction the student has taken, he/she must still come to the college and take the common final exam for that course. The final exam is mandatory for all developmental math class students and is given as a paper-and-pencil test. The final exam for each course was created by the former chairperson of the department in consultation with other math instructors within the department. The need for final exams is two-fold: First, they are used as a way of demonstrating that the state competencies for student outcomes have been met; second, they are used as a means of setting an exit standard for each course.

The college also offers late-start developmental math classes. These math classes are offered after the beginning of the official semester. They are typically offered as online classes. Sometimes the term *second-chance class* is also used to describe a late-start class. These classes are conducted in the same manner as the online classes described earlier. These late-start classes are offered as a way to accommodate those students who, for one reason or another, are unable to start a class at the beginning of the semester. Typically there is only one developmental math class per semester that is offered as a late-start class.

Each student is required to take a final exam. The final exam for each developmental math course (MAT 060, MAT 070, and MAT 080) consists of 50 questions. Each question is worth two points. The MAT 060 final exam consists of multiple-choice questions only. The MAT 070 and MAT 080 final exams have a combination of multiple-choice and short-answer questions, with multiple-choice questions making up the majority of the 50 questions. The short-answer questions are used for the questions on factoring polynomials and for word problems. If these questions were asked as multiple-choice questions, then the student could look at the answers and find which one correctly answered the question without actually working through the problem. By having the student come up with the correct answers on his/her own means that the student is demonstrating that he/she knows how to factor and how to solve word problems. While the questions are called short-answer, there is only one correct answer for each one. The term *short-answer* comes from the label used in the test generator program that is used to create these tests. All the questions are worth two points and there is no partial credit given. These final exams were developed by the former department chair in consultation with the math instructors within the developmental education department.

The overall progress of each student at the college is measured using a computer program that was developed by the Information Services Section of the North Carolina Community College System Office. This program provides grade information on students who successfully completed developmental courses and who then took college-level courses. This program also provides grade information on students who enrolled in college-level courses without having been required to take developmental courses. This historical data is available at the college from the Department of Institutional Effectiveness. This historical data was examined to determine the overall effectiveness of the developmental math program over the past 5 years in meeting the two state standards of passing rates and performance in subsequent college-level math classes. Currently, the state standards are that 75% or more of developmental math students will receive a grade of C or better, and that 80% of former developmental math students who go on to take college-level math classes will receive a grade of C or better. This information is displayed in Chapter 4 in Table 9. There are two columns in Table 9 with the headings of “Passing Rate of Students in Developmental Math at College A” and “Performance of Developmental Students in Subsequent College-Level Courses at College A.” The five columns are labeled as the school years of 2004 through 2009, and the data within the table show the percentages of each group who met both of the state standards for developmental math.

All the students who were included in this study and who were in a developmental math class in the spring of 2010 took the placement test (pretest) as part of the enrollment process. At the end of the spring 2010 semester, the students took the placement test again (the posttest). Included in the posttest was a survey (Appendix E) which included questions about the demographics (race, gender, and age) of the students; the math class that they were currently taking; whether that class was a day class, an evening class, a hybrid class, or an online class; questions about the placement test; and questions about the effectiveness of the developmental math program. When the survey was being created, the researcher included some extra questions as a means of collecting some additional data at that time. For the purposes of the program evaluation, survey data on race, age, gender, placement test, and the effectiveness of the developmental math program were utilized. The data from the pretest and posttest, and from this survey, were coded and then entered into an SPSS program and the results were displayed in tabular form. The student ID numbers were used as codes for the data in the pretests, posttests, and in the surveys. The information that was entered in the spreadsheet included the items of student IDs, their age at their last birthday, race, gender, ethnicity, whether or not they felt that the COMPASS® test placed them correctly, whether or not the current math class was helping them, and if they believed that the program was doing a good job or not, and their pretest and posttest scores. This method of collecting, coding, and analyzing the data is discussed in greater detail in Chapter 3.

Surveys were given to the former developmental math students who went on to take college-level math classes (Appendix F). These were students who experienced the program and who were currently in their first college-level math class. The method of data collection, coding, and analyzing the data from these surveys is also discussed in detail in Chapter 3.

Purpose of the Project

The purpose of this study was to determine the effectiveness of the developmental mathematics program at the college. In addition to comparing the grades of former developmental math students with students who tested above the cut score for developmental math at the end of their first college-level math class, this study looks at the factors of race, gender, and age in the spring semester of 2010. This provides a more detailed analysis of how well, or how poorly, each subgroup of former developmental math students did in a college-level math class as compared to those students who did not take any developmental math classes. Prior to this study, that information was not readily available to the developmental education department. There was no way of knowing if the current developmental program did a better job with White, Black, or Hispanic students; with males or females; or with those in certain age groups. With the data being broken down into the three subgroups of race, gender, and age, it will enable the decision makers to have a more detailed understanding of the developmental math program. At the conclusion of this study, suggestions and recommendations are made to the relevant decision makers with the overall goal of improving the quality of the program for all students. Since there has never been a program evaluation conducted on the developmental math at the college, there was no data to show if the students and instructors felt as if the program was doing what it is supposed to do. This study surveyed the current developmental math students and asked them if they believed that the program was working for them at that time. It surveyed former developmental math students and asked them if the program had prepared them for college-level math. During the interviews with developmental math instructors and college-level math instructors, questions were asked as to whether or not these instructors believed that the program was working. These surveys and interviews are discussed in more detail in Chapter 3.

Program Evaluation

Fitzpatrick et al. (2004) described several types of program evaluation orientations including objectives-oriented, management-oriented, consumer-oriented, expertise-oriented, and participant-oriented evaluation. The present program evaluation plan is based on management-oriented principles, which are “meant to serve decision makers” (Fitzpatrick et al., 2004, p. 88). According to Sanders and Sullins (2006), “program evaluation is the process of systematically determining the quality of a program and how it can be improved” (p. 1). The evaluation model that was used in this program evaluation is the CIPP Evaluation of School Curriculum model created by Stufflebeam (2002). The model was chosen for its comprehensive nature as related to curriculum development and evaluation. The CIPP model is discussed in more detail in Chapter 2. Using the CIPP Evaluation Model (Fitzpatrick et al., 2004) as a framework, the researcher constructed the research questions accordingly. The CIPP Evaluation Model consists of a framework of four different components: context, input, process, and product. The CIPP Evaluation Model is discussed in more detail in Chapter 2.

The current remedial math program at the college is modeled on the standards (competencies) put forth by the North Carolina Community Colleges System (NCCCS) in their Developmental Competency Review Project, dated May 1, 2000. These competencies are included as Appendices A, B, and C. There are currently three levels of remedial mathematics being offered at the college: MAT 060 – Essential or Basic Math, MAT 070 – Introductory Algebra, and MAT 080 – Intermediate Algebra. These courses are sequential in nature. When a student takes the placement test, he/she receives a placement score. This score is used to place the student in a particular math class as demonstrated by the chart in Appendix D. If a student places into MAT 060, that student must pass the course and the final exam in order to progress to the MAT 070 class. If the student fails the course or withdraws, then that student must repeat the course. If a student who placed into MAT 060 wishes to take college algebra, MAT 161, that student would first have to take and pass MAT 060, MAT 070, and MAT 080. If a student scores within the retest range, he/she has the option of either retaking the placement test or not.

As a major component of the study, the results of the pretest and posttest were coded and entered into an SPSS program. The data was examined to see if there was any change in the test scores over the course of the semester. Another measure of the effectiveness of the program was an analysis of the amount of change in scores from the pretest to the posttest. A control group of students were also asked to participate in the study. These were students who placed into a developmental math class, but who had not actually taken a developmental math class since taking the placement test. They retook the placement test again and this retest was referred to as the posttest. The scores of these students were used as a control group. The methods for collecting and analyzing this data are discussed in more detail in Chapter 3.

Using the placement test as a pretest and posttest was the first time that the test has been used in this manner. There has never been a program evaluation carried out on any remedial or developmental program at the college.

Research Questions

In order to help guide the study, the following research questions were compiled. It is hoped that these questions will lead to a better evaluation and understanding of the overall effectiveness of the developmental math program at the college. Table 1 presents the research questions, key indicators, data sources, and methods that were used to guide this program evaluation.

Table 1

Program Evaluation Matrix

Evaluation Questions	Key Indicators	Data Sources/Methods
1. What are the conditions leading to the necessity of a developmental mathematics program at the college level?	Articulated goals and objectives Description of students in the program Opinions Placement scores	Historical records from state and local level Interviews Placement scores
2. What other attempts have been made to solve the problem?	Description of other attempts	Interviews Historical records College catalogs Existence of other programs
3. How does the implementation of the developmental math program at this college align with recommendations for appropriate instruction of developmental math students?	Reported research-based strategies The number of the key components in this program when compared to other successful programs The median score of each component	Literature Review Comparison with other successful programs Median score for each component on Appendix I Surveys
4. How is the developmental math program at the college being implemented?	Student and instructor perceptions Course Evaluations System office data	Student surveys (frequency distribution) Instructor interviews and surveys (thematic frequency distributions and frequency distributions)
5. How effective is the developmental math program at the college?	Opinions Student growth and achievement	Data analysis Surveys of students and math instructors and interviews of math instructors Student records, institutional data, and test scores (measures of central tendency) COMPASS® tests, pretests, and posttests

Participants

Participants included those students who had experienced the program prior to, or were experiencing the program during the spring semester of 2009. For comparison purposes, and to use as a control group, 17 students who took the placement test (the pretest) but who did not take a remedial math class during the semester, were asked to take the posttest (the placement test) also. Students who had experienced the program previously, and had then gone on to take a college-level math class were also included in this study by way of the survey in Appendix F. The chairperson of the developmental program, five full-time developmental math instructors and seven part-time developmental math instructors were participants in the surveys regarding their experience of the developmental math program at the college. Four of the full-time college-level math instructors and two part-time college-level math instructors were also participants in the survey as they deal with many of the students who have taken developmental math classes. Surveying these college-level math instructors provided feedback on their opinions regarding the developmental math program from the perspective of the college-level math instructor who teaches both former developmental math students in the same classroom setting with those students who did not have to take developmental math classes.

Research Timeline

Preliminary content analysis of the program competencies was reviewed in order to gain an understanding of the developmental math program prior to the actual evaluation. Data collection, including interviews, surveys, and reviews of students' records were conducted between March 2010 and August 2010. The students already had taken the pretests in the form of the COMPASS® placement test administered by the college. The students began taking the posttests in April 2010 and this reflected their progress in developmental math up to that point as many of them already had taken at least one developmental math class. Some of the participants may also have taken two developmental math classes at that point in time, and may have been in their third and final developmental math class. Formative summaries were given periodically to the chairperson of my dissertation committee until the executive summary and dissertation were presented in the spring of 2011.

Significance of the Study

Developmental math instruction, particularly for students who are unprepared for college-level math, must be effective in order for students to become academically successful in college or university coursework. The results of this program evaluation will give indicators for revision and validation for methodology as it is implemented in the particular setting. The results will also contribute to the body of literature on effective developmental math curriculum programs for college students. This information is important to developmental students, developmental instructors, counselors, faculty advisors, and administrators.

Summary

Math remediation has become a contentious issue in recent years. Some states have attempted to limit the way in which remediation is provided at the college level. With more and more students wanting to go to college, it would appear as if this is a hindrance to them. As thousands of students seek to earn a college degree, it is estimated that between 30% and 50% of them will arrive on a college campus needing one or more remedial classes. The majority of this remediation takes place at 2-year colleges.

This college is one such college where developmental courses are offered. Although the current developmental math program has been in existence since 1994, there has never been a thorough evaluation conducted on this program. The current method of comparing students who took developmental math classes with those who did not is not providing sufficient data about the overall effectiveness of the program. A more detailed study is required. A program evaluation format using the CIPP model has been chosen for improvement and validation purposes of the Developmental Mathematics Program at the college. The summarized data is presented in dissertation format to Gardner-Webb University as partial fulfillment of the degree requirements for the Degree of Doctor of Education. The executive summary format was presented in manuscript form to the stakeholders at the college.

Chapter 2: Review of Related Literature

Introduction

In this chapter, the primary focus of the literature review was to uncover what was already known about successful developmental education programs and the methods used to evaluate them. This information was then used as a comparison with the program that was already in place at the college, and to help select the methods and instruments used to conduct this evaluation. The literature review in this chapter has been arranged in the following manner. The first topic is a brief history of remediation followed by one of the most widely discussed topics about remediation – the cost. These are followed by the theoretical underpinnings of remediation, such as learning theory and cognitive theory. Putting these theories into practice would be the next logical progression, so the literature review follows these theories with a discussion of the topics of instructional methods and learning communities. The next logical progression from there would be to ask who is going to deliver this instruction, which is why a discussion of faculty comes next in the literature review. After this, the literature review is broadly separated into two main parts. The first part reviews the literature that deals with developmental programs, whereas the next part reviews the literature that deals more with individual students. The topics that relate to the overall programs are the philosophy, the commitment to remedial education, having centralized programs, mandatory placement, orientation for students, counseling, and flexibility. The topics that relate more to the individual student are such items as tutoring, self-efficacy, math anxiety, and study skills. The chapter also includes a literature review of the topics of supplemental instruction, the importance of program evaluations, and course evaluations. At the end of the chapter is the literature review outlining the rationale for selecting the CIPP model for the program evaluation as well as the rationale for using the mixed-methods approach of using both qualitative and quantitative data, and the instruments used to collect this data.

A Brief History of Remediation

Remediation is arguably as old as higher education in America, dating back to the 1630s when Harvard College provided tutors in Latin for incoming students. The first remedial education program was offered at the University of Wisconsin in 1849 with remedial courses in reading, writing, and arithmetic. There were *preparatory* departments in existence throughout the 19th century at many universities. In the 20th century, junior colleges began to take over the leading role in remedial education, but many 4-year institutions still kept some remnants of their remedial programs. It was within these junior colleges that the remedial programs expanded as the college population grew as a result of the *open door* policy provided for by the Higher Education Act of 1965. The 1970s saw a steady increase in the number of institutions offering developmental education. Legislatively mandated testing began in the 1980s, and most states discovered that about 30% to 40% of first-year community college students needed remediation in at least one of the areas of reading, writing, or math. This percentage was borne out again in 1996, when a survey conducted by the National Center for Education Statistics (NCES) found that 41% of first-year community college students needed remediation. This study was repeated again in 2004 by the NCES and it was found that roughly the same percentage of students needed remediation.

The Cost of Remediation

One topic that is mentioned often in the review of the literature on developmental/remedial education is the cost. The estimates for the annual cost of providing developmental/remedial education vary between $1 billion and $2 billion. This is about 1% of the overall budget of $115 billion of the combined sources of higher education revenue from state allocations, federal support, and student tuition (Breneman & Haarlow, 1998). Saxon and Boylan (2001) conducted a study of the cost of remedial education in higher education and presented some interesting findings. They found that it was difficult to get an accurate figure on the cost of remediation as states have various methods of reporting these costs. The data that they looked at were dynamic and subject to change, so the cost estimate was only a good estimate for that point in time. They stated that "remediation is a relatively small expense in higher education, especially given the size of the population that benefits from it" (Saxon & Boylan, 2001, p. 2). Given that about 41% of community college students and 30% of university students are engaged in remedial courses (National Center for Education Statistics, 1996), and that it is estimated that 1% of the overall budget of colleges and universities is spent on remedial courses, it appears that a relatively small amount is being spent to benefit a large group of students.

There are also indirect benefits to providing remediation. Abraham (1998) argued that if 30% of remedial students earn bachelor's degrees, these students would contribute as much as $87 billion in federal and state taxes over their working careers. This is more than double the estimate of $43 billion that these students would contribute should they be denied access to higher education.

Theoretical Underpinnings

Learning theory. John Roueche and his colleagues at the University of Texas at Austin were responsible for conducting much of the early research on the effective techniques for providing remediation. A review of the available literature on this subject indicated that between 1968 and 1978, Roueche and his colleagues published more books and articles on remedial education than all the other authors in the field combined. It would make sense that any discussion of effective techniques, models, and other methods for remediation must refer back to the early work of Roueche and his colleagues.

In the beginning, their research was based on reviews of the literature to identify components of learning theory and how this applied to remedial courses (Roueche, 1968; Roueche & Wheeler, 1973). The behaviorist model was the predominant model in the learning theory of the time, and so many of their findings were heavily influenced by this behaviorist thinking. Behaviorist techniques tended to be successful with remedial students, and much of the literature that recommended these techniques has been validated by later research in this area. One of the most important findings of their research was the importance of establishing clear-cut goals and objectives for remedial courses (Roueche, 1968; Roueche, 1973). Later studies by Donovan (1974), Cross (1976), Kulik and Kulik (1991), and Boylan et al. (1992) also found that remedial instruction based on clearly defined goals and objectives was associated with improved student performance. When the goals of a particular course are clearly defined and the instructor’s expectations are clearly stated, it makes it easier for the underprepared students to accomplish their learning goals. Roueche and his colleagues also emphasized mastery learning as a component of effective remedial instruction (Roueche, 1968; Roueche & Wheeler, 1973). They were greatly influenced by the work of Bloom (1968) and Carroll (1963) in this regard. Mastery learning involved the use of small units of instruction and frequent testing and required students to be able to master the material in one unit before moving on to the next unit. Research by Cross (1976), and Kulik and Kulik (1991) has also strongly supported the use of mastery learning for remedial courses. Students taught using mastery learning techniques in remedial courses were more likely to pass these courses, obtain higher grades, and be retained, than students whose remedial courses were taught using more traditional techniques (Boylan et al., 1992). A recent study of remedial courses in Texas community colleges also found that students taught using mastery learning techniques were more likely to pass a statewide achievement test in the remedial subject area than students taking remedial courses which did not use mastery learning techniques in the classroom (Boylan & Saxon, 1998).

Cognitive theory. Another early finding from the work of Roueche and his colleagues was that remedial courses were most effective when they were based on sound cognitive theory (Roueche, 1973; Roueche & Kirk, 1974; Roueche & Wheeler, 1973). Citing the work of Bruner (1966) and a variety of other instructional theorists, Roueche (1973) argued that remedial instruction should be systematic and clearly based on what we know about how people learn. These findings are supported in later work by Stahl, Simpson, and Hayes (1992) and Casazza and Silverman (1996). A recent study of Texas community colleges found that students were more likely to pass a state mandated achievement test following remediation when remedial courses were based on recognized theories of teaching and learning (Boylan & Saxon, 1998).

Variety of instructional methods. Again, these early findings have been supported through later research. Cross (1976), Kulik and Kulik (1991), and Casazza and Silverman (1996) all found that students in remedial courses were likely to be more successful when a variety of instructional methods were used. No researcher, however, suggests that instructors tailor instruction to each individual student. Instead, researchers recommend that instructors use a variety of instructional methods to reach the largest number of students (Boylan, 2002; Claxton & Murrell, 1988; Felder, 1996; Felder, 2005; Felder & Silverman, 1988; Maxwell, 1997).

The body of research suggesting that remedial students learn in ways other than by the traditional methods of instruction has been growing. Canfield (1976) found that students enrolled in community college remedial courses were much more likely to be either visual or hands-on learners than other students. Using a modified version of the Kolb Learning Styles Inventory, McCarthy (1982) found that weaker college students tended to be more visually oriented or more inclined to learn through direct experience than other students. Lamire (1998) cited studies of community college students indicating that the predominant learning style among them was visual, followed by what he referred to as haptic or learning by doing. The use of a variety of instructional methods, particularly those using visual or hands-on approaches to learning, were more likely to appeal to the learning styles of students who are typically enrolled in remedial courses.

Learning communities. The use of learning communities in remedial courses has also been found to improve the performance of students participating in remediation. Learning communities have combined courses and groups of students organized as cohorts. Typically, these cohorts of students took courses linked together by a common theme, and instructors of these courses functioned as a team to insure that the content of each course was related to and supportive of the other courses (Adams & Huneycutt, 1999).

The use of paired courses has offered another example of the learning community concept. A reading course, for instance, might be *paired* with a social science course and students would enroll as a cohort in both courses. The instructors of these two courses would then collaborate to insure that concepts taught in reading related directly to what was being learned in sociology courses (Adams & Huneycutt, 1999).

Tinto (1997) found that underprepared students participating in remedial courses organized around the principles of learning communities had better attitudes toward learning and had higher course completion rates than students in traditional remedial courses. In later research, Tinto (1998) found that the use of learning community concepts to teach remedial courses resulted in improved retention for participating students. Commander, Stratton, Callahan, and Smith (1996) found that participating in paired courses improved student performance and resulted in higher levels of reported student satisfaction.

Faculty

The use of full-time and part-time (adjunct) faculty. All researchers recommend employing full-time instructors to teach developmental coursework. In addition, researchers recommend hiring instructors who have been trained to work with adult students and underprepared students, as well as those instructors who have a strong background in educational theory, learning theories, English as a second language (ESL), curriculum development, or instructional design (Boylan, 2002; Boylan & Saxon 1998; McCabe, 2003; Roueche & Roueche, 1993; Roueche & Roueche, 1999).

Research shows that nationally the majority of developmental mathematics courses are taught by adjunct faculty. While Maxwell (1997) stated that students who take developmental mathematics courses with adjunct faculty do not perform as well in other nondevelopmental math courses as those who took the course with a full-time instructor, other studies show no significant difference between the performance of students who took courses with adjunct faculty and those who took courses with full-time faculty. A difference was noted only when 70% or more of the courses were taught by adjunct faculty (Boylan, 2002). When institutions do use adjunct faculty, they should receive training regarding the department's grading policies and expectations, learning styles, technology available for supplemental instruction, and the academic support available on campus (Maxwell, 1997; Boylan, 2002). Boylan (2002) further recommended that senior faculty provide mentoring for adjunct faculty, adjunct faculty should attend all developmental education and departmental meetings if possible, and a resource manual should be provided during orientation.

Faculty training. Many authors have described the importance of training for those who work with underprepared students (Casazza & Silverman, 1996; Maxwell, 1997; Roueche, 1973). Recent research has validated the need for faculty and staff working with remedial programs to be specifically trained in the techniques, models, and methods appropriate for helping underprepared learners. Boylan et al. (1992) found that students were more likely to pass remedial courses, earn higher grades, and be retained longer if remedial programs placed a strong emphasis on professional development for faculty and staff. Later analysis of data from this study indicated that the training of staff contributed to increased effectiveness of individual program components such as instruction, counseling, and tutoring, as well as to overall program effectiveness (Boylan, Bliss, & Bonham, 1997). The importance of professional training of those working with underprepared students has also been emphasized in the work of Casazza and Silverman (1996) and Maxwell (1997).

Clearly defined philosophy. Early studies of remediation also recommend that successful programs should have a clearly defined philosophy, as well as clearly specified goals and objectives (Roueche & Snow, 1977). Later work by Casazza and Silverman (1996), Maxwell (1997), and Boylan and Saxon (1998) reinforced this finding. The presence of an overarching program philosophy accompanied by program goals and objectives based on this philosophy tended to define successful programs. This finding has been incorporated into the guidelines of professional associations for program certification. Certification guidelines established by the National Association for Developmental Education (Clark-Thayer, 1995) require that programs seeking certification include a copy of their program philosophy and describe the program goals and objectives based on this philosophy as part of the requirements for obtaining certification.

A commitment to remedial education. Roueche and Roueche (1993, 1999) and Roueche and Baker (1987) argued that an institution-wide commitment to remedial education was a key factor in the success of community college remediation. An institution-wide commitment to the benefits and value of remediation was highlighted through public administrative support for remediation, appropriate allocation of resources for remediation, and institutional emphasis of remediation as a mainstream activity for the community college. In their study of Texas colleges and universities, Boylan and Saxon (1998) found that remedial programs integrated into the academic mainstream of the institution had higher pass rates in remedial courses and were more successful in retaining students than programs that were not integrated. As an institutional priority, developmental education should be a part of the institution's long range plans and be included in the mission statement and other publications of the college (Boylan, 2002).

Centralized programs. Roueche and his colleagues recommended that remedial courses and services should be provided by a separate and centralized program as opposed to individual academic departments (Roueche & Kirk, 1974; Roueche & Snow, 1977). This finding is validated by Donovan (1974), and Boylan et al. (1992). Boylan (2002) noted decentralized programs are characterized by

> regular meetings of all those involved in the delivery of developmental courses and services, articulation of common goals and objectives for all developmental courses and services, integration of developmental courses and academic support services, and coordination of developmental courses and services by an administrator with primary responsibility for campus-wide developmental education. (p. 11)

Students involved in centralized remedial programs were found more likely to pass their remedial courses and more likely to be retained for longer periods of time than students participating in decentralized programs. Recent analysis of these findings suggests that it is not a centralized program structure alone that provides for success but rather the smoothness of the coordination and communication among the faculty within a centralized program (Boylan et al., 1997). However, decentralized programs in which there is strong coordination of remedial education and plenty of communication among those who teach remedial courses may be just as effective as centralized programs (Boylan et al., 1997).

Developmental Programs

Course alignment. Boylan et al. (1992) found that remedial courses were most effective when regular efforts were made to insure consistency between the exit standards for remediation and the entry standards for curriculum courses. A recent Texas study (Boylan et al., 1996) found that a surprisingly large number of institutions made no effort to determine if what was taught in remedial courses prepared students for success in curriculum courses. At institutions where such consistency was assured, students passing remedial courses had a high likelihood of passing later curriculum courses (Boylan et al., 1992). Roueche and Roueche (1999) also argued for this consistency in their recent recommendations for improving the performance of college remedial programs.

Mandatory placement. Mandatory assessment and placement of students in remedial courses has also been identified as a characteristic of successful remediation programs (Roueche & Baker, 1987; Roueche & Roueche, 1993; Roueche & Snow, 1977). Other authors have continued to promote the use of mandatory assessment and placement (Casazza & Silverman, 1996; Maxwell, 1997; Morante, 1987; Morante, 1989). The early identification of those students at risk of failure was found to be associated with successful remediation (Adelman, 1999; Kulik, Kulik, & Schwalb, 1983). This seems to support the argument for mandatory assessment and placement. Mandatory placement in remedial courses appeared to have a statistically significant, negative impact on the retention of students in remedial programs (Boylan, Bonham, & Bliss, 1994). While this may appear at first glance to be inconsistent, Boylan et al. (1997) argued that this is a result of a change in the types of students enrolled in remedial courses because of mandatory placement. When placement is voluntary instead of mandatory, a large number of the most poorly prepared students fail to enroll in, or avoid, remedial courses. When these students drop out, they are not counted in the data by the remedial program as they were not registered in that group. Voluntary placement tends to prevent a large number of the weakest students from being included in the program's service population. The students participating in remedial courses under a voluntary placement system tend to be more highly motivated or to recognize the need for developing their skills before enrolling in curriculum courses. They are also more likely to be successful than less motivated and less realistic students. When placement is mandatory, a higher percentage of academically weaker and less motivated students are taking remedial courses. These students are among the least likely to be successful in remediation. This contributes to the negative relationship between mandatory placement and student retention when the results of voluntary placement are compared to the results of mandatory placement (Boylan et al., 1997). As Cross (1976) pointed out, fewer than 10% of those needing remediation are likely to survive in college without it. Even though large numbers of the weakest students will become victims of attrition under systems of mandatory placement, more will survive than if they had not received any remediation at all.

Orientation for students. Community college remedial programs have recently begun providing organized college orientation seminars for their students. Although the freshmen seminar was initially developed for university students, this concept has since been successfully implemented at many community colleges (Upcraft & Gardner, 1989). Because community college students were likely to be the first generation of their family to attend college, they tended to be unfamiliar with the expectations and rewards of a college education. It should come as no surprise that they frequently failed to meet these expectations. College orientation courses were useful tools for helping students learn what was expected of them and assisting them in adjusting to the college environment. Recent research (Gardner, 1998) has shown that underprepared students participating in ongoing orientation courses were much more likely to be retained in the community college than students who did not participate in these courses.

Remedial students not only have been less likely than others to understand the expectations and rewards of college, they also have been less likely to understand the types of thinking required for success in college courses. The emphasis of critical thinking throughout the remedial curriculum has proven successful in improving the performance of underprepared students. The work of Chaffee (1992) and his colleagues teaching critical thinking at La Guardia Community College has been particularly impressive in its impact on underprepared students. Participation in courses, programs, and activities designed to enhance critical thinking has improved students' performances in reading and writing (Chaffee, 1992; St. Clair, 1994-95), improved students' attitudes toward learning (Harris & Eleser, 1997), and contributed to higher grade point averages and retention (Chaffee, 1998).

Counseling component. Early research also found that successful remedial education programs had a strong counseling component (Roueche & Mink, 1976; Roueche & Snow, 1977). This relationship between an emphasis on personal counseling for students and successful remediation was supported in later research by Keimig (1983), Kulik et al. (1983), Boylan et al. (1992), the Higher Education Extension Service (1992), and Casazza and Silverman (1996).

Currently, there are three basic models for academic advising: prescriptive, developmental, and intrusive. Prescriptive advising can be described as what often occurs between advisor and advisee. The advisor helps the student plan courses, drop, add, or withdraw, and answers questions about various program requirements. The advisor accepts responsibility for the advice, and if a mistake is made, the student "does not feel responsible" (Heisserer & Parette, 2002; McCabe, 2003, p. 62). The advisor is active and the student is passive.

Developmental advising, on the other hand, utilizes a holistic approach to the student. To advise a student developmentally, the advisor is typically trained in student development theory; students are challenged to achieve their full academic potential; students are viewed as partners in the process of their intellectual and personal growth; advisors help students set forth their personal and academic goals and assist these students in setting short-term and long-term goals (King, 2005).

The third model is called *intrusive advising* (Earl, 1987), and it is a combination of the other two methods. Walter Earl (1987) described the intrusive model of advising as

> action-oriented to involving and motivating students to seek help when needed. Intrusive advising is a direct response to an academic crisis with a specific program of action. It is a process of identifying students at crisis points in their academic life and giving them the message, "You have this problem; here is a help-service." (p. 3)

Overall, the advisee must play an active role in "establishing goals, objectives, and a plan of action" by seeking out information about careers and his/her individual learning preferences (Earl, 1987, p. 5). The advisor then helps the student to work through the crisis and build a plan for the future. Key skills are needed for intrusive advising: communication, questioning, and referral (Heisserer & Parette, 2002).

Bourdon and Carducci (2002) pointed out that the combination of prescriptive and developmental advising works by helping students "to develop critical thinking skills and self-direction in setting long-term academic and career-oriented goals," and they admit that "while academic advising requires additional financial and human resources, it is still cost effective when retention rates are figured into the program" (p. 36).

This research indicated that counseling by itself was not sufficient to seriously affect student success. In order for counseling to be successful with remedial students it had to (a) be integrated into the overall structure of the remedial program (Kiemig, 1983); (b) be based on the goals and objectives of the program (Casazza & Silverman, 1996); (c) be undertaken early in the semester (Kulik et al., 1983); (d) be based on sound principles of student development theory (Higher Education Extension Service, 1992); and (e) be carried out by counselors specifically trained to work with developmental students (Boylan et al., 1997).

Flexibility. McCabe (2003) noted "an effective assessment and placement program, however, requires flexibility" (p. 144). He gave the example of Santa Fe Community College in Florida that allows students the opportunity to be reassessed on the first day of class in order to confirm that the students have indeed been placed in the correct level of math class. Students who have been misplaced are reassigned. Boylan (2002) also claimed that allowing reassessment is necessary because no test can be 100% accurate, and so it is important to allow students an opportunity to challenge placement because students will feel that they have had "a fair chance to demonstrate their abilities" (p. 38). The American Mathematical Association of Two-Year Colleges (AMATYC, 2006) also advocated having an appeal process in place for students who may be misplaced by the assessment instrument. The AMATYC (2006) and the NADE Math SPIN (2003) suggested that students who are planning on taking a placement test should prepare themselves by reviewing practice materials provided by the institution.

Students

Tutoring. The importance of tutoring remedial students has been widely discussed in the literature. Early studies of remediation suggest that tutoring is an important component of successful programs for underprepared students (Roueche & Snow, 1977). Maxwell (1997) argued that research findings on the impact of tutoring on underprepared students are mixed with no conclusive results being found. Additional studies by MacDonald (1994), Casazza and Silverman (1996), and Boylan et al. (1997) help to explain this apparent inconsistency. It would seem that the overall effectiveness of tutoring is strongly influenced by the quality and the amount of training received by the tutors who provide the tutoring. This is particularly true when the subjects of tutoring are underprepared students. Boylan et al. (1992) found that there was no difference in the performance of students participating in remedial programs whether they received tutoring or not, unless the tutoring program included a strong tutor training component. As MacDonald (1994) pointed out, tutors will be ineffective unless they are able to consistently and usefully apply strategies appropriate to each student's situation. This can only be accomplished through the appropriate training. Boylan (2002) recommended that all tutors undergo the College Reading and Learning Association Tutor Training Certification Program as a way to move beyond the typical procedures and record keeping that commonly makes up most tutor training. Casazza and Silverman (1996) argued that successful tutor training programs include "learning theory, metacognition, motivation, counseling/interviewing, group dynamics, and adult learning models" (p. 110).

McCabe (2003) also noted research completed by Gourgey (1992) that showed that students in developmental math often internalize the reasons for their poor math skills. Such students often respond positively to tutoring because "educationally and economically disadvantaged students tend to feel more relaxed with peers and relate to them in a more personal way, especially if they are enrolled at the same college" (McCabe, 2003, p. 64). However, the tutors must help "them to talk, analyze errors, respond to the affective as well as the cognitive needs, reassess the learning process, and then use real-life applications to cement learning" (McCabe, 2003, p. 64). None of this can occur without the training discussed by Boylan (2002) and Casazza and Silverman (1996).

Computer-based instruction. Much research has been conducted on the effect of computer-based instruction in the past decade. In an analysis of computer-based instruction at 123 colleges and universities, Kulik and Kulik (1986) found that the use of the computer as a tutor designed to supplement regular instruction had several positive effects. These included (a) more student learning in less time; (b) slightly higher grades on posttests; and (c) improved student attitudes toward learning.

In a later review of research on the use of computers with underprepared students, Kulik and Kulik (1991) found that "computer-based instruction has raised student achievement in numerous settings" (p. 32). Roueche and Roueche (1999) found that the use of computers for students to complete writing assignments and as a tutor in mathematics contributed to the success of remedial courses. The AMATYC (2006) acknowledged that technology should be "an essential feature" of teaching mathematics and the organization suggests that instructors of developmental mathematics classes "actively seek ways to integrate technology into developmental mathematics courses in order to develop and investigate concepts" (p. 33).

Using data from the National Study of Developmental Education, Bonham (1992) found that the effectiveness of computer-based instruction declined when it was used as the primary delivery technique in remedial courses. Computer-based instruction appeared to be most successful when it was used as a supplement to regular classroom activities in remedial courses. When computer-based instruction was used in this way, students were more likely to complete remedial courses and to earn higher grades (Bonham, 1992). These findings were later verified in work by Maxwell (1997) and a study of remedial programs in Texas (Boylan & Saxon, 1998). A good program or software should provide preassessment to determine where students need to begin their studies; the programs provide manageable units of information, opportunities for practice, frequent testing, a variety of media, feedback on student progress, and assessment of skill mastery (McCabe, 2003). Overall, computer-aided instruction can provide many of the benefits of individualized instruction, mastery learning, and active learning, all instructional strategies that have been shown to be extremely effective pedagogical techniques for use in any developmental classroom (AMATYC, 2006; Boylan, 2002; Boylan & Saxon, 1998; Casazza & Silverman, 1996; Maxwell, 1997; McCabe, 2003). One reason for its effectiveness is that "for many developmental students, the use of technology in the instructional process affords a fresh start, different from typical approaches associated with previous failures" (McCabe, 2003, p. 103).

Self-efficacy and math anxiety. "Research indicates that, for developmental mathematics students, academic self-concepts, attitudes toward success in mathematics, confidence in ability to learn mathematics, mathematics anxiety, self-efficacy, and locus of control are all variables that affect student goals, performances, and attainments in mathematics" (Hall & Ponton, 2005, p. 26). Maxwell (1997) also noted that the fear of math and lack of self-efficacy can have a negative impact on student performance. "Researchers have found that high-risk students with low self-efficacy fail to learn even under optimal conditions" (Maxwell, 1997, p. 143).

Math anxiety and poor performance history in previous math courses can combine to create continued poor performance in mathematics courses. *Math anxiety* is described as a feeling of dread that is experienced when a person attempts to understand and solve mathematics problems.

> Attitudes toward mathematics can enhance or inhibit learning, influence confidence in learning mathematics, impact on the perception of the usefulness of mathematics, and create mathematics anxiety. Depending on the degree of

> mathematics anxiety, such fears can develop into “learned helplessness,” the belief that one is unable to do mathematics at all. (AMATYC, 2006, p. 15).

AMATYC (2006) and Noel-Levitz (2005) recommended that instructors understand the influence that a student’s attitude can have on that student’s ability to perform well in class. Hall and Ponton (2005) further argued that developmental mathematics instructors, by offering students the ability to be successful in an area in which they have had little or no prior success, can help create a greater sense of self-efficacy, which, in turn, can create more successful college experiences for students.

Study skills. Maxwell (1997) noted that no matter what strategies for learning have been tried in the classroom, students often revert to memorization and continue to fail math courses. Researchers have noted that students often have difficulty transferring skills from stand-alone study skills courses into other courses, so the NADE Mathematics Special Professional Interest Network (2003) recommended that study skills should be taught as an integral part of the academic course.

Research in the past decade has identified several other factors that contribute to successful remedial courses and programs. Boylan et al. (1997), for instance, found that integrating classroom and laboratory instruction was associated with student success in remedial courses. When classrooms and laboratories were integrated, instructors and laboratory personnel worked together to insure course objectives were directly supported by laboratory activities. Boylan and Saxon (1998) found that the integration of classroom and laboratory instruction in this manner was also related to student success on a state-mandated achievement test in Texas.

Structure. Another concept that was emphasized in the early research was that of structure. Roueche (1973) found that students taking remedial courses needed a high degree of structure for their learning experiences in order to be more successful. Cross (1976) later argued that remedial students tended to lack the organizational ability necessary to comprehend many academic concepts. By providing these students with a very structured learning experience and by modeling appropriate methods of organizing information, the students were able to perform much better in their learning. Based on their research on the interaction between student aptitude and instructional methods, Cronbach and Snow (1977) also argued that structured learning environments provided the most benefit to the weakest students. This research was further supported by the works of Kulik and Kulik (1991) and Boylan et al. (1992). The use of a variety of different teaching methods was also recommended in the early studies of remedial instruction (Roueche, 1968; Roueche & Wheeler, 1973). The method of direct instruction (or lecture) has been used in the past with students in remedial courses, but it was found to have little effect on their learning. As a result of these findings, Roueche and his colleagues argued for the use of a wide variety of teaching techniques such as class discussions, group projects, and various other types of learning.

Supplemental Instruction

Supplemental instruction has also been demonstrated as an effective technique for improving the performance of students in remedial courses. In supplemental instruction, a specific course (usually one in which there are high rates of failure) would be supported by supplementary, small-group sessions scheduled as part of the course. These small-group sessions were run by a student leader who attended the course, took notes, and then met with students to hear recitation, give quizzes, discuss course material, and assist students in studying effectively.

Martin and Arendale (1994) cited numerous studies in which students enrolled in courses supported by supplemental instruction consistently outperformed students in more traditional courses. Ramirez (1997) cited long-term evidence suggesting that underprepared students who participated in supplemental instruction were retained at higher levels than students who had not.

Of particular note is a recent version of supplemental instruction called video-based supplemental instruction or VSI. Video-based supplemental instruction uses videos of lectures to support the points made in small-group sessions. This technique is reported to be particularly effective with underprepared students (Martin & Arendale, 1998).

An emphasis on strategic learning also has contributed to the effectiveness of remedial courses. In the early 1980s, Claire Weinstein argued that underprepared students do not know how to acquire and process information and must, therefore, be taught to monitor their comprehension and think strategically about learning (Weinstein, 1982). In short, remedial students had to learn to recognize when they did not comprehend material and then be able to apply alternative strategies to improve their comprehension. Weinstein and her colleagues expanded these concepts and developed a comprehensive model for teaching underprepared students to think strategically (Weinstein, 1988; Weinstein & Rogers, 1985). When this model for strategic thinking processes was integrated into the remedial curriculum, students became more effective learners, obtained higher grades, and were retained over longer periods of time (Weinstein, Dierking, Husman, Roska, & Powdrill, 1998).

The Importance of Program Evaluations

Another key finding has been the importance of program evaluation to the success of remedial education. Donovan's (1974) analysis of successful programs for at-risk students found that those colleges that evaluated their programs on a regular and methodical basis were more successful than those who did not. This finding was repeated in Roueche and Snow's (1977) study of other successful remedial programs. Boylan et al. (1992) later found that program evaluation was positively related to student grades in remedial courses and also associated with the long-term retention of remedial students. Analysis of data from the National Study of Developmental Education suggests that the relationship between program evaluation and student success had a great deal to do with how program evaluation information was used after it had been presented. Programs were more successful when evaluation included a combination of formative and summative evaluation, and when formative evaluation data was used as an action plan in order to improve the program (Boylan et al., 1997).

Course Evaluations

A course evaluation usually takes place at the end of a semester, usually a week or 2 before the last day of class. The evaluation is performed by the students who are still enrolled in the class. Students have the opportunity to reflect on the instructor's instruction without fear of punishment because course evaluations are completely confidential and anonymous. Typically, these evaluations are given in a paper-based format. The evaluations are distributed by a student while the instructor is out of the room. They are then sealed in an envelope and the instructor will not see the summarized results until after final grades are submitted. The handwritten comments that students write on these evaluations are usually typed up before being given to the instructor as another measure of protecting anonymity. The online version of an evaluation can be identical to a paper version or more detailed, using branching question technology to extract more information from the student. Both ways allow the student to be able to provide useful and honest feedback. This feedback is to be used by instructors to improve the quality of their instruction. The information can also be used to evaluate the overall effectiveness of an instructor, particularly for tenure and promotion decisions (Mohanty, Gretes, Flowers, Algozzine, & Spooner, 2005). Student evaluations are deemed to be formative when their purpose is to help faculty members improve their teaching skills (Mohanty et al., 2005). From the student point of view, effective student course evaluation provides a means to communicate to faculty some suggestions for the purposes of instructional improvement. Students take their course evaluation role seriously, believing that they are fair and that they can identify effective teaching (Beran & Violato, 2005; Campbell & Bozeman, 2008).

CIPP Evaluation Model

The CIPP Evaluation Model (Fitzpatrick et al., 2004) consists of a framework of four different components: context, input, process, and product. Context evaluation is utilized in order

> to define the institutional context, to identify the target population and assess its needs, to identify opportunities for addressing the needs, to diagnose problems underlying the needs, and to judge whether proposed objectives are sufficiently responsive to the assessed needs. (Stufflebeam, 2002, p. 91)

Input evaluation is used "to identify and assess system capabilities, alternative program strategies, procedural designs for implementing the strategies, budgets, and schedules" (Stufflebeam, 2002, p. 91). Process evaluation is used "to identify or predict in process defects in the procedural design or its implementation, to provide information for the preprogrammed decision, and to record and judge procedural events and activities" (Stufflebeam, 2002, p. 91). Product evaluation is used "to collect descriptions and judgments of outcomes and to relate them to objectives and to context, input, and process information and to interpret their worth and merit" (Stufflebeam, 2002, p. 91).

Other studies have used the CIPP model in order to provide decision makers with the information they need concerning the effectiveness of the programs. Frye, Solomon, Lieberman, and Levine (2000) used the CIPP model to evaluate the Integrated Medical Curriculum (IMC) at the University of Texas Medical Branch. This model was chosen to provide information for the improvements in the IMC. Results of this evaluation led to changes in the grading practices and textbook selections of the IMC courses.
Project INSITE is a school-based project funded by the National Science Foundation. Lehman and Mandell (1977) used the CIPP model to evaluate the Project INSITE teacher-training program taking place during the summer of 1996 in Indiana. This evaluation was conducted to assess the process and product categories of the CIPP model with a focus on the training evaluation. The evaluation included both qualitative and quantitative data collection methods in order to provide the decision makers with information. The data included such items as the INSITE program components, how the teachers were implementing the program in their own classroom, changes in teaching practices, participants' attitudes toward the training, and new knowledge attainment.

The CIPP model was also used to evaluate five after-school programs in northeast Kansas (Kraft, 2001). These programs were part of a 21st Century Learning Centers' grant requiring a strong evaluation plan as a component of the grant. The CIPP model was selected because it focuses on the decision-making processes that occur at all levels of the program, and it facilitates program improvement, which are major goals of any after-school program (Weiss, 2000). Due to the short timeframe for the funding of the program it was important to utilize a comprehensive evaluation process that would provide detailed insights into the inner-workings of the program – from the conception of the after-school program model to the implementation at each of the school sites (Kraft, 2001). The latter two studies show that the CIPP model is a good choice when a short timeframe is a consideration. This particular study at this college was limited to one semester for which the CIPP model was ideally suited.

A program evaluation approach has been selected for several reasons. There is very little literature regarding the success of remedial math programs at the community college level, so this evaluation will contribute to that literature base. This math remediation program serves approximately one-fifth of the student population, so any investigation regarding the effectiveness of the program is informative. Most importantly, however, is the concern that this program may not be improving the math ability of students in order to adequately prepare them for a college-level course in mathematics. As mentioned above, the CIPP model allows for the evaluation of the context, input, process, and product of the program, so from an administration or curriculum director standpoint, the information will be useful in the decision-making process.

Research Methods

This program evaluation used both qualitative and quantitative methods. A review of qualitative research on a particular subject used in conjunction with quantitative research on the same subject has been shown to provide richer insights and raise more interesting questions than when only one of these methods is used alone (Gall, Gall, & Borg, 2003). This approach has come to be known as mixed-methods research. The researcher in this evaluation employed a mixed-methods approach.

Surveys were used in the data collection process and the rationale for using this method was discussed in the literature. Surveys are often used in evaluation to measure attitudes, opinions, behaviors, life circumstances, or other issues. Braverman (1996) in his review of surveys in evaluation stated that, “Surveys constitute one of the most important data collection tools available in education” (p. 17). When the purpose of the survey is to measure opinions, behaviors, or attitudes quite specific to the program to be evaluated, the evaluator is likely to be faced with developing his own instrument (Fitzpatrick et al., 2004). In the surveys used in the program evaluation, the researcher included both multiple-choice items and Likert-scale items based on the recommendations put forth by these authors. The multiple-choice format was selected when the questions related to the demographics of gender and race, and also in the type of math class. The Likert-scale format was selected when the questions were asking for the students’ opinions such as how they felt about their placement in a particular class as a result of the placement test, or if their current math class was helping to improve their math skills, or if they believed the developmental math program was doing a good job. The same rationale was used when creating the survey given to the former developmental math students since they were asked very similar questions. Since each student selected to participate in the study was given one of these surveys to complete, a return rate of 100% was obtained. However, not all the surveys were fully completed due to the fact that a student could choose not to answer the questions on the survey. The researcher made the decision to include or exclude those surveys based on the data that were needed. For example, if the student indicated his/her gender and ethnicity on the survey, but did not indicate his/her age, then the researcher used that survey when answering questions on gender and ethnicity, but omitted this survey data when answering questions on age.

Interviews were also used as part of this program evaluation. The researcher interviewed all four of the full-time developmental math instructors, seven part-time developmental math instructors, four full-time college-level math instructors, and two part-time college-level math instructors. The researcher conducted these interviews in a face-to-face manner using both a notepad and a tape recorder to record the interviews. This method is based on the recommendations put forth by Fitzpatrick et al. (2004) in their book, *Program Evaluation*. If the goal of any research is to understand the meaning that people make of their educational experience, then conducting interviews is a necessary way of achieving that goal (Seidman, 1998). The interviews for developmental math instructors consisted of 12 questions (Appendix G) and a question asking them to complete a checklist. The Interview Guide for College-level Math Instructors (Appendix H) follows a similar format of questions but omits the questions that relate to teaching developmental math classes as these instructors do not teach developmental math classes. They were also asked to complete the checklist in Appendix I.

Researchers attempt to discover something about a large group or population by studying a small group called a sample (Gall et al., 2003). In addition to the purpose of the study and population size, two criteria needed to be specified to determine the appropriate sample size: the level of precision and the level of confidence (Miaoulis & Michener, 1976). A precision rate of ±5% was adopted for this study along with a confidence level of 95%. In order to determine the sample size required for any study, there are published tables available to assist the researcher. Using one such table, the criteria stated above, and a population of 1,200, a minimum sample size of 300 is suggested (Creative Research Systems, 2007).

There are many types of sampling methods that can be employed. A simple random sample means that every member of the population has an equal chance of being chosen. The researcher used this method in selecting former developmental math students and those students who did not take a math class prior to the spring semester of 2010 in order to be included in this study.

Summary

Much has been written about remedial/developmental education in the last 30 years. Many researchers have carried out several studies on the various aspects of remedial and developmental education, and this has contributed greatly to our understanding of what works in developmental education. Having a clearly defined philosophy should be a key component of any developmental education program. One of the major findings in the research is that it appears as if those programs that conduct ongoing program evaluations have more successful programs than those who do not. It is also clear from the research that there should be mandatory testing and placement of students, a system-wide commitment to developmental education, and a well-trained faculty who are capable of providing a variety of instructional methods. Students in developmental education need assistance in areas such as counseling, orientation, study skills, and structure. More recent researchers have focused on the problems of math anxiety and self-efficacy, while others have focused on the effects of computer-based instruction. Much has been discovered in the last few years and the researchers continue to provide information that will lead to a better understanding of developmental education. As part of the evaluation of the developmental math program at the college, it is evident that many of the proven ways and means of successful programs from the literature review are in existence at the college. The CIPP model was used in evaluating the program as it has been deemed to be more suited to this type of research. A mixed-methods approach to collecting the data was used to enhance construct validity (a form of methodological triangulation) as is now routinely advocated by most methodologists. In short, mixing or integrating research strategies (qualitative and/or quantitative) in any and all research undertaking is now considered a common feature of all good research. The term mixed-methods refers to the fact that a mixture of collecting quantitative and qualitative data was used in this evaluation. Quantitative data refers to data that are numerical and were used in the areas of pretests, posttests, as well as in the examination of historical data. Qualitative data refers to data that are non-numerical in nature such as surveys, interviews, and records of meetings. This literature review in Chapter 2 has provided insight as to why the researcher employed the methods and instruments that were used in this program evaluation. Chapter 3 includes the details of how the researcher used these methods and instruments used to collect and analyze the data.

Chapter 3: Methodology

Introduction

This program evaluation was conducted as a case study using the CIPP Evaluation Model for several reasons. The CIPP Evaluation Model is a comprehensive framework for guiding evaluations of programs, projects, personnel, products, institutions, and systems, particularly those aimed at effecting long-term, sustainable improvements. Corresponding to the letters in the acronym CIPP, this model's core parts are context, input, process, and product evaluation. The model's main theme is that an evaluation's most important purpose is not to prove, but to improve (Stufflebeam, 2002). In general, these four parts of an evaluation respectively ask (1) what needs to be done; (2) how should it be done; (3) is it being done; and (4) did it succeed.

This study examined the effects of math remediation on student learning, explained who got remediated and why, and determined the extent and in what capacity the program was being implemented at College A. This chapter describes the population/sample, the instrumentation that was used, the interviews, the test data, the procedures for each of the research questions, validation, limitations, and delimitations of the study.

Population/Sample

The setting is a 2-year community college in the southeastern United States with the majority of the students coming from the two surrounding counties. The students come from a mixed socioeconomic background. In the spring of 2009, the enrollment in the curriculum classes (a total of 7,140 students) was split into 34% men and 66% women. The ethnicity was reported as 78% White, 15% Black/African American, 5% Hispanic, and the remaining 2% was split between the ethnicities of American Indian, Asian, mixed-race, and those who did not respond. Fifty-one percent were less than 25 years of age; 22% were between 26 and 35 years of age; 27% were 36 years of age or older. Seventy percent of the students came from the county where the main campus is located; 18% from the adjoining county where the second of three campuses is located; and the remaining 12% were from somewhere other than these two counties.

Instrumentation

The instruments that were used in this program evaluation were surveys, interviews, pretests, posttests, a checklist, a consent form, and a debriefing form. The surveys were given to both current and former developmental math students. These surveys were first given to a small group of approximately 20 students as a way of checking their wording and accuracy prior to being given to the sample population. These 20 students were not part of the actual study. These students were asked to submit feedback by writing comments on the survey, or by verbally communicating their opinions on the wording of the survey to the researcher in order to improve the clarity of the questions. Based on this feedback, some minor changes to the wording were made.

Interviews were conducted with developmental math instructors, college-level math instructors, and at least one instructor present at the college when the program was moved to its current location. These surveys and the checklist had already been sent for review purposes to Mr. Patrick Saxon who is a primary researcher at the National Center for Developmental Education in Boone, North Carolina. Minor editing changes recommended by Mr. Saxon were incorporated into the wording of these instruments.

All of the students who were attending the college had already taken the COMPASS® placement test (unless exempted based on the appropriate SAT scores) and this was referred to as the pretest. The college administers this pretest as a requirement for admission to the college. The students who were selected to participate in this study retook the placement test at the end of the spring semester 2010. This was referred to as the posttest. The checklist (Appendix I) was given to the instructors as part of the interview process. The use of these instruments is discussed below. The consent form (Appendix J) was given to all the participants outlining the purpose of the study, the voluntary nature of the study, confidentiality, and contact information. All participants were asked to sign the consent form before being allowed to participate in the study. After they had taken the survey or been interviewed, each participant received a copy of the debriefing form (Appendix K) assuring them of their confidentiality and the contact information of the researcher.

Interviews

Interview guides for developmental math instructors and nondevelopmental math instructors (college-level math instructors) are located in Appendices G and H, respectively. The checklist in Appendix I was also used in the interviewing process. Interviews were conducted in a face-to-face manner, audio recorded and transcribed. The primary focus of the interviews was to find out how the instructors felt about the three main items of (1) the placement test, (2) whether or not the developmental math program was doing a good job of preparing students for college-level math, and (3) whether or not the developmental math program was doing a good job overall. The researcher initially included other questions in the initial research as a way of uncovering any previously unknown concerns among the instructors. Since the researcher did not find any such concerns, it was decided to omit those responses that did not focus on the three main items mentioned above. The information from the surveys is displayed in a table and described in narrative form in Chapter 4.

Test Data

One measure of knowledge acquisition is test data (Fitzpatrick et al., 2004). In this study, student test data were partly historical because of the research timeline. Students had already taken the placement test (pretest) prior to the beginning of this study. The students retook the placement test again (posttest). The data from the pretest and the posttest were entered into SPSS for statistical analysis (mean, median, mode, and standard deviations). These measures of central tendency gave indicators of growth of the participants over time. Students were labeled by code to protect anonymity. In addition, various *t*-tests were conducted in comparing the mean scores of different groups. Results are displayed in tabular form and described in a narrative in Chapter 4.

Research Questions

Research Question 1: What are the conditions leading to the necessity of a developmental mathematics program at the college level? According to Fitzpatrick et al. (2004) existing information, documents, and records should be the first source of consideration. Because these materials were not prepared for the evaluation, they gave a more realistic picture of the values and perspectives of the participants and the settings. The documents and records that were reviewed were the historical records from both the State Board and the local college, the college catalogs, and the literature on developmental students showing the success rates of developmental and nondevelopmental students. Findings from the documents are discussed in narrative form in Chapter 4.

The researcher also conducted interviews with a developmental math instructor who taught at the college when the program was first created. The main focus of the interview was to find out the conditions that led up to the creation of a developmental math program. The research questions that guided the interview are shown in Appendix L. The interview was recorded and the narrative was transcribed. As a means of validating the conditions that led up to the creation of a developmental math program, the researcher examined historical records such as the college catalogs, minutes from meetings, and memos, relating back to the time leading up to, and including, the creation of the developmental education department in order to corroborate the reasons for the need for such a department. The results are discussed in the narrative in Chapter 4.

Research Question 2: What other attempts have been made to solve the problem? This question was included in the interview questions for the developmental math instructors (Appendix G), the college-level math instructors (Appendix H), and for the instructor who was involved in the early years of the current program (Appendix L). These interviews were transcribed and a narrative was created showing what other attempts had been made at the college in the past to assist those students who needed help in math. There was only one instructor available for an interview for this part of the evaluation who was also involved in the early years of the current developmental education program. That instructor provided no additional insight into the attempts that were made to solve the problem other than what was contained within the college catalogs. His interview did corroborate the historical data. Other historical records such as college catalogs and departmental records showing the availability of services such as tutoring, a learning lab, videos, DVDs, and other supplemental materials were researched in the process of this program evaluation. These services are also included and discussed in the narrative in Chapter 4.

Research Question 3: How does the implementation of the developmental math program at the college align with recommendations for appropriate

instruction of developmental math students? In order to answer this question, it was necessary to compare what is known about successful math remediation programs with the program that is in place at the college. Appendix I is a list of 20 items compiled by Hunter R. Boylan and D. Patrick Saxton from the National Center of Developmental Education that they believe are components of a successful program. Appendix I was included in the interview questions for the developmental math instructors (Appendix G) and the college-level math instructors (Appendix H). These instructors were asked during their interviews to circle the number on the Likert scale that best described their response to each question for all those items in Appendix I. These surveys were collected and the data was entered into the SPSS program. The rows of the spreadsheet were numbered 1 through 20 and these numbers corresponded to the numbers on each question. The headings were the instructor code from each sheet. The Likert scale response from each instructor for each question was entered into the table. Based on the literature review from Chapter 2, a good developmental program should contain as many as possible (if not all) of these components. Using the median score for each question as an indicator, if a question had a score of 3 or less, it was an indication that the program did not contain this component or that it was not being fully implemented within the program. If the mean score was above a 3, it was assumed that the instructors felt that the component was in place within the program. The results were tallied and displayed in tabular form. As a means of triangulation of these results, the researcher examined course descriptions, syllabi, assessment materials, mission statements, and other materials for verification that these components from Appendix I do exist and are part of the developmental math program. A discussion of these results is included in Chapter 4.

Research Question 4: How is the developmental math program at the college

being implemented? Each student from the sample population who was taking a developmental math class in the spring of 2010 was given a survey to complete (Appendix E). Question 4 on the survey asked the student if he/she felt that the placement test put him/her in the correct math class. A Likert scale was used for the responses. Question 5 asked the student if he/she believed that the developmental math program was doing an adequate job of preparing him/her for college-level math using the same Likert scale. Question 6 asked the student about his/her opinion about the overall developmental program. Former developmental math students who were taking a college-level math class during the spring semester of 2010 were also given a survey. Their surveys included these same three questions but were numbered as questions 2, 3, and 4 as shown on Appendix F. The developmental math instructors and college-level math instructors were asked questions for their opinions on these same three questions as shown in Appendix G and Appendix H, respectively. The Likert scale responses to each of these three questions from each of the four groups (current developmental math students, former developmental math students, developmental math instructors, and college-level math instructors) were entered into the SPSS software program. The results were converted into percentages for each group and by each question. The data were then displayed in tabular form and discussed in the narrative.

Research Question 5: How effective is the developmental math program at the college? All of the current developmental math students in this study had taken the placement test prior to being placed into a developmental math class as part of the college admission process. This placement test was referred to as the pretest. After having experienced at least one developmental class, over 700 of the students from various math classes participated in this study. Over 600 of these students were in the developmental math program and over 100 of them were taking a college-level math class at that time. The developmental math students were asked to come to the computer lab during a 3-week time period between the hours of 8 a.m. and 8 p.m. in order to retake the placement test. This 3-week time period was selected based on a time that is most convenient for the director of the computer lab. The researcher and three other people had been trained on administering the placement test. One of those four people was available in the computer lab at all times. Each student had to log onto the computer and follow the directions for retaking the placement test. There was survey (Appendix E) that the student had to take prior to the beginning of the actual test. The test itself lasted approximately 30 minutes. After completing the test, the students logged off the computer. The scores from the first time they took the placement test (the pretest) and the scores from the second time they took the placement test (the posttest) were coded and entered into an SPSS program. The data from the survey along with the pretest and posttest scores were coded and entered into an SPSS program. The column headings and the heading codes for the data were student ID (A), age at last birthday (B), gender (C), ethnicity (D), level of math class (E), placed correctly (F), is current math class helping to prepare you for college math (G), is the program doing a good job (H), pretest scores (I), and posttest scores (J). This data was entered in to an SPSS program. The information above (A through J) was used as the column headers. The information from the surveys was entered into the rows based on the responses from the surveys. Starting with the first column, the student ID was entered, directly followed by their age at their last birthday in the next column. Column C was for the data on gender. If a student indicated they were male, a number 1 was entered in the column. If a student indicated they were female, a number 2 was entered in that column. Column D was for ethnicity. Depending on the responses from the surveys, a number from 1 to 4 was entered into that column. These numbers corresponded to the following: Caucasian/White 1, African American/Black 2, and Hispanic 3. If a student selected one of the other answer choices of Asian/Pacific Islander, Alaskan/Native American, other, or prefer not to respond, a number 4 was entered into that column. The current data from the college shows that these categories comprise less than 2% of the population. Column E is for responses about the type of math class the student was taking at that time. If a student indicated that they were taking MAT 060, a 1 was entered; MAT 070, a 2 was entered; MAT 080, a 3 was entered; and if they indicated that they were not taking a math class, a 4 was entered. In the next column, a number 1 through 5 was entered based on the number indicated on the Likert scale by the respondent on the survey sheet as to their opinion about the placement test. The last two questions on this survey also used a Likert scale. Again, based on the responses, a number 1 through 5 was entered into columns G and H. The next column was for the pretest scores. This was the score that the student made on the placement test when he/she first took the test. Immediately following that was the column for posttest scores. This is where the scores from the second time the students took the test were entered. The pretest scores and the posttest scores were provided to the researcher by the director of testing. After all the data had been entered, they were analyzed using the different sorting and filtering features in the SPSS. These features were used to analyze the data to look for trends in the data. Several *t*-tests were conducted in order to compare the means of these different groups. The results of this analysis were displayed in tabular form as well as discussed in narrative form in Chapter 4.

There was also a simple random sample of students selected who qualified to take a developmental math class, but who had not taken one of the courses prior to the time this study was carried out. The researcher had hoped to obtain a sample of at least 30 students, but only 17 students actually participated in this part of the study. The researcher obtained a list of approximately 200 students from the Registrar's office who met these criteria. The researcher contacted these students by email, phone, and a hand-delivered flyer via one of their instructors informing the students that they were invited to participate in this study. They came to the computer lab during a 3-week period in order to take the posttest. They also took the survey in Appendix E, but only answered the questions on demographics. The scores from the pretest and posttest were entered into an SPSS program. The headings used were student ID (A), date of birth (B), gender (C), placed correctly (G), pretest scores (K), and posttest scores (L). This data was analyzed using the different sorting and filtering features on the SPSS program. The results of this analysis were displayed in tabular form as well as being discussed in narrative form.

Approximately 250 students who had taken at least one developmental math class and were currently taking a college-level math class in the spring semester of 2010 were asked to participate in this study. The instructor contacted these students by email or by a letter via their math instructor informing them that they were invited to participate in this study. They were given the survey in Appendix F to complete. A follow-up with a reminder email and message via their instructor was sent after 2 weeks if they had not turned in their survey. Out of the approximately 250 students who were asked to participate, 140 of them actually participated, which is close to a 56% participation rate. The data from these surveys were entered into an SPSS program using the following headings: student ID (A), age at last birthday (B), and gender (C). If a student indicated that they were male, the number 1 was entered in the column. If a student indicated that they were female, the number 2 was entered in that column. Column D was for ethnicity.

Depending on the responses from the surveys, a number from 1 to 4 was entered into that column. These numbers correspond to following: Caucasian/White 1, African American/Black 2, and Hispanic 3. If a student selected one of the other answer choices of Asian/Pacific Islander, Alaskan/Native American, other, or prefer not to respond, a number 4 was entered into that column. Columns E, F, and G were for responses about the type of developmental math class or classes that the student took. Column E corresponded to MAT 060. Column F corresponded to MAT 070. Column G corresponded to MAT 080. The next question on the survey asked if they believed the placement test placed them in the correct math class. This question corresponded to column H in the SPSS program. A Likert scale was used in this question, so the number indicated by the students on the survey was the number that was entered in for the student. The scale ranged from 1 through 5 as described earlier. The next two questions also used a Likert scale. The first one asked if the student believed that that developmental math class or classes helped to prepare the student for college-level math, and the second question asked if the student believed that the developmental math program was doing a good job. The responses to these questions were entered into columns I and J, respectively. The results of this analysis were displayed in tabular form as well as discussed in narrative form.

Validation

Triangulation of sources was used to ensure validity of the qualitative data. This triangulation process helped to control for biases in the data (Gall et al., 2003) and provided support for the conclusions in this study. As described above, interviews, surveys, and content analysis were used as sources for the program evaluation.

Limitations of the Study

1. There is no one set math remedial program in place. Each instructor decides how best to present the material. The amount of time spent on each topic, the number of assignments and tests, and the way that the student's grade is calculated is up to each individual instructor.

2. Students had access to other forms of assistance such as tutoring, DVDs that accompanied the textbook, and online math help from MyMathLab.com. This was beyond the control of the researcher and may have affected the results of the study.

3. The researcher served as an internal program evaluator and conducted all the interviews. While the developmental math instructors and the college-level math instructors were reminded to give their honest opinions in order to highlight any areas that needed improvement, the researcher was aware that this may have been a limitation in the study.

Delimitations of the Study

1. The study of the math remediation program was limited to collecting data from the 2009-2010 school year only.

2. The sample population for this study was limited to those students who were enrolled at the college at that time.

3. There were not enough students who took the placement test (pretest) and who did not take a remedial math class (the treatment), and who were available to retake the placement test (posttest) in order to act as a control group for the study.

4. The placement test had two math parts to it – a pre-algebra part and an algebra part. As a result, most of the students received a pre-algebra score (COMPA score) or an algebra score (COMA score). However, there were some cases where a student only

received a pre-algebra score on the pretest and only an algebra score on the posttest. So if a student took the placement test (pretest) and got a COMPA score, but after experiencing the developmental math program the student got a higher score in the COMA score range, the researcher could not calculate a numerical change in these scores. In order to avoid ambiguity when using similar terms, the researcher decided to use the term *arithmetic score* in place of the term *pre-algebra score*. The term *algebra score* remained the same throughout.

Summary

The mathematics remediation program at the college is designed to help students build their math skills in order to be successful in college-level math courses. Currently, only those students who remediate successfully are compared to those who placed directly into a college-level math class. This comparison does not present enough information about the success of, or the shortcomings of, the math remediation at the college. The purpose of this study was to determine if the remediation program was doing what it was supposed to do, and to answer the questions of who was benefitting the most and who was benefitting the least from this remediation. The program evaluation that guided this study was the CIPP model. This model is used to inform decision makers about the context, inputs, processes, and overall program evaluation. Data used in the evaluation process were both quantitative (data analysis) and qualitative (document analysis, surveys, and interviews). Using both methods is referred to as a mixed-methods approach. The data were analyzed using the functions in the Excel program and the SPSS 18.0 computer program. Triangulation was used to check for consistency of data and the results were presented in tabular and narrative form in Chapter 4. The study concludes with recommendations for the program based on this analysis.

Chapter 4: Data Analysis

Introduction

The purpose of this study was to evaluate the developmental math program through program evaluation as it was implemented in the participating community college. Stufflebeam's Evaluation CIPP model (2002) was the framework for the study. Both qualitative and quantitative collection methods were used including surveys, interviews, and content analysis of pertinent documents. This portion of the study reports the data collected and is organized by the following five research questions: (1) what are the conditions leading to the necessity of a developmental mathematics program at the college level; (2) what other attempts have been made to solve the problem, (3) how does the implementation of the developmental math program at the college align with recommendations for appropriate instruction of developmental math students, (4) how is the developmental math program at the college being implemented, and (5) how effective is the developmental math program at the college.

Research Question 1: What are the conditions leading to the necessity of a developmental mathematics program at the college level? Content analysis was performed on pertinent school documents including course catalogs, state memos, and college-board minutes. Colleges and universities must sustain at least some minimal level of enrollment in order to continue to function. To sustain enrollment, they cannot limit themselves only to those who are immediately fully prepared for college-level work. Consequently, colleges and universities must admit substantial numbers of students who are not yet fully prepared for college. This does not mean that such students cannot be successful. It simply means that they will need some extra help in order to do so. Developmental programs provide this help. Cross (1976) estimated that only about 10%

of the students who are unprepared for college work would be likely to graduate without developmental education courses and services. Students generally do not exit from developmental courses or programs until they are capable of doing college-level work. The purpose of developmental programs is to develop students' skills so that they can meet academic standards. By improving students' academic skills, developmental programs also make it possible for more students to persist in college while meeting higher academic standards (Boylan et al., 1992; Keimig, 1983; Roueche & Snow, 1977). Developmental educators, therefore, contribute to the preservation of academic standards. Since 1964, the state community college system has offered a variety of resources for students who needed some extra assistance in order to be successful at the college level. These include tutoring, programmed instruction, computer-based learning, and formal classes being the main delivery methods. When the state college system changed from individual course catalogs in the quarter format to the common courses in the semester format in 1997, developmental education was formalized into courses (Lang, personal communication, March 2, 2007). On July 1, 1993, the North Carolina State Legislature (SL 1993-321, Section 108) established a special provision for *remediation measures* to manage the standards for placement testing at community colleges.

> Sect. 108 (a) The State Board of Community Colleges shall study the different tests by colleges to place students in developmental courses. This study shall determine appropriate tests and proficiency levels to be used in selecting and placing students in developmental courses.
>
> (b) The State Board shall report its findings to the General Assembly by May 1, 1994. (North Carolina General Assembly, 1993, p. 97)

On August 24, 1996, the State Board of Community Colleges adopted a revised

Placement Testing Policy, which included placement test cut scores to establish proficiency levels for students entering college-level courses. This policy became effective in the fall semester of 2007 for all students enrolling in curriculum-level courses with a developmental prerequisite. From then on, all colleges in the North Carolina Community College System began using the validated test scores as included in the policy to demonstrate student proficiency and college readiness in reading, writing, and mathematics (NCCCS, 2006).

On August 18, 2006, the State Board of Community Colleges adopted a revised policy which in part stated that mandatory testing and placement is required for all students taking curriculum-level courses with a developmental prerequisite (NCCCS, 2006). This policy also included provisions for placement test waivers based on ACT and SAT scores, the use of placement tests, retesting, a table of test scores, and the establishment of a placement test committee. The purpose of this placement test committee as outlined in this memo is to review the placement test policy at least twice annually and to make recommendations to the State Board for changes as needed (NCCCS, 2006).

The college in this evaluation appears to have followed the State Board's recommendations and policies throughout the years. While reviewing the course catalogs for all the years for which the catalogs were readily available (1964-2010), it seems as if the terms *basic studies* and *developmental studies* were used at various times, up to and including the 1992-1994 course catalog. It appears that there has always been a placement system in place at the college to help students with course selection. In the early years, there was a *Guidance Battery Test* which was used as a placement guide. It is unclear if the placement in remedial courses was mandatory as the wording states that the student “may be required to make up their deficiencies” (College Catalog, 1967, p. 19). In 1979, the college catalog stated that students had to take the American College Test (ACT) for placement purposes. English, reading improvement, and mathematics were the developmental courses that were offered at that time, but again the wording used is “advised to consider enrollment in developmental courses” (College Catalog, 1979, p. 10). In 1985, the college catalog wording changed to state that students whose ACT scores fell below the prescribed scores for their chosen program “can be required to take developmental courses” (p. 11). The following school year in 1986, both the ACT and the SAT (Scholastic Aptitude Test) were accepted for placement purposes. In the 1992 catalog, the actual placement scores for the ACT and SAT are listed saying that developmental math is required if the ACT math score is below 18 or if the SAT math score is below 375. Then in 1996, the college began using the ASSET test for placement purposes. This coincides with the State Board policy on placement scores mentioned above. The changeover to the ASSET test also occurred around the time when the college changed over from the quarter system to the semester system. The college began using the ASSET test and the recommended placement scores (Appendix D) in order to place students into the newly created common courses in developmental education. The college continued using this ASSET test up until 2003 when it was replaced by the COMPASS® (Computer-Adaptive Assessment and Support System) placement test. This was a local decision based on the fact that the COMPASS® test was available for students to take on the computer whereas the ASSET test was a paper-and-pencil test (D. Dellinger, personal communication, September 14, 2010). This COMPASS® test is the placement test that is still in use at the college at this time.

A thorough review of other historical records at the college did not yield any additional information. It appears as if remediation has always been available at the college. In the early years, remediation was suggested for those who scored poorly on the Guidance Battery Test. Over the years, the remediation became more organized and placement testing became mandatory as a result of several mandates from the State Board of Community Colleges. The cut scores and the course offerings were regulated by the same board and College A follows these guidelines. Placement of a student depends on how well or how poorly that student performs on the placement test. The placement scores are set by the state and are displayed in Appendix D.

Research Question 2: What other attempts have been made to solve the problem? According to course catalogs dating back to 1964, the college has been offering some type of remedial coursework since that time. It appears from reading these catalogs that prior to 1990 there was no mandatory placement of students into remedial or developmental courses based on a college placement test. The wording in the catalogs up to this point suggests that a student "may be required to make up their deficiencies" (College Catalog, 1967-68, p. 19), or that a student "may be advised to schedule remedial non-credit courses before undertaking the regular credit courses" (College Catalog, 1964, p. 12), and as late as 1987 where it stated that "Some students may be requested to enroll in special courses to eliminate scholastic deficiencies" (College Catalog, 1986, p. 11). In the 1990 catalog on page 16, there is the first mention of placing students into developmental courses based on their Scholastic Aptitude Test (SAT) scores or their American College Test (ACT) scores. In the 1994 catalog on page 37, there is the first reference made to the developmental courses by name. It also describes how students were placed into developmental English, developmental math, or developmental reading if their scores were below a certain cut score on either the SAT or ACT (College Catalog, 1992, p. 37). The ASSET placement test is first mentioned in the 1994 catalog as being used for placement purposes at the college. This would coincide with a special provision from the North Carolina General Assembly, effective July 1, 1993, that the State Board of Community Colleges shall study the different tests used by colleges to place students in developmental courses (SL 1993-321, Section 108). Apparently the ASSET was used up to, and including, 2002 when the college then began using the COMPASS® test in order to place students into certain classes. The COMPASS® test is still in use today. On August 18, 2006, the State Board of Community Colleges adopted a revised policy which in part states that mandatory testing and placement is required for all students taking curriculum level courses with a developmental prerequisite (NCCCS, 2006).

According to a former dean of the division, instructors at the college offered tutoring for many years to students outside of the regular classroom hours (D. Dellinger, personal communication, August 27, 2010). Each instructor would organize his/her own tutoring session and there was no coordinated effort in place. According to the minutes from the meeting of the College Board on June 7, 1982, there was an establishment of a more formal system into a Developmental Education Program. There appears to have been a small Developmental Education Learning Center available as it is mentioned within other documents. This center was then staffed with one part-time coordinator and several tutors. In 1996, the college established a Learning Center in order to help students in a more formal and coordinated way, and it was staffed by a full-time coordinator and several tutors. In January of 1998, the Learning Center moved into a newly renovated building where it is still located at the present time. The Learning Center is made up of many different parts. It has a computer lab where students can use the computers to do their work, get assistance with online work, watch DVDs, and receive help from a trained tutor. There is also a peer-tutoring center whereby students can receive help from tutors in a particular subject. These tutors are students who have demonstrated a certain mastery of the subject in which they are tutoring. They undergo a training session in the Learning Center before they begin to tutor. Students who need assistance in a certain subject are encouraged to come by the Learning Center and sign up for free tutoring. The tutors work one-on-one with each student, usually for about an hour at a time and up to 3 hours per week. There is also a resource center located in the Learning Center where students may borrow various materials such as handouts, DVDs, books, and videos.

A retired instructor who taught at the college in the 1980s until his retirement in 2005 was interviewed for this program evaluation. His recollection of the events reflects what is contained within the historical records. His interview did not yield any additional information with regards to the developmental math program.

Research Question 3: How does the implementation of the developmental math program at the college align with recommendations for appropriate instruction of developmental math students? Much of the early research on effective techniques for providing remediation was conducted by John Roueche and his colleagues at the University of Texas. Their research was based on reviews of the literature to identify components of learning theory most applicable to remedial courses (Roueche, 1968; Roueche & Wheeler, 1973). Most of their findings focused on the importance of establishing clear-cut goals and objectives for remedial courses (Roueche, 1968; Roueche, 1973). Later studies by Donovan (1974), Cross (1976), Kulik and Kulik (1991), and Boylan et al. (1992) also found that remedial instruction based on clearly defined goals and objectives was associated with improved student performance. Other studies also showed that the specification of course goals and objectives also led to the establishment of a clear course structure, which was another component of successful remediation.

Based on the literature review of over 200 pieces of literature, Hunter Boylan and D. Patrick Saxon (2005) from the National Center for Developmental Education prepared a report titled *What Works In Remediation: Lessons from 30 Years of Research.* Using this report as a template, the researcher created a checklist (Appendix I) showing 20 acceptable practices that should be part of any successful developmental education program. D. Patrick Saxon reviewed the checklist in November 2009 and made some suggestions prior to the use of the checklist in this study. This checklist was given to all the developmental math instructors and the college-level math instructors at the college as part of the interview process. The data from the returned surveys were analyzed and are discussed below. The instructors completed the Likert scale by indicating the number that best describes their responses to each question using the following:

1 = Strongly Disagree

2 = Disagree

3 = No Opinion

4 = Agree

5 = Strongly Agree

Table 2

Math Instructors' Survey Results from Appendix I

Statement	Developmental Math Instructors (n=12)	College-level Math Instructors (n=6)
1. There are clearly established goals and objectives for developmental math courses.	5.00	4.00
2. Mastery learning techniques are used in developmental math courses, i.e., students do not move on to another topic until they have mastered the current topic.	4.00	3.00
3. There is a high degree of structure in developmental math courses.	4.00	4.00
4. A variety of approaches and teaching methods are used in developmental math instruction.	4.00	3.00
5. There is sound cognitive theory in the design and delivery of developmental math courses.	4.00	4.00
6. A centralized and coordinated developmental math program is in place.	5.00	4.00
7. Formative evaluation is used to guide program development and improvement.	4.00	4.00
8. There is a strong philosophy of learning in place in order to deliver program services.	4.00	4.00
9. Mandatory placement testing is in place.	5.00	5.00
10. A counseling component is integrated into the structure of developmental education.	4.00	4.00
11. Tutoring is performed by trained tutors.	4.00	4.00
12. The classroom and laboratory activities are integrated.	5.00	4.00

(continued)

Statement	Developmental Math Instructors (n=12)	College-level Math Instructors (n=6)
13. There is an established college-wide commitment to developmental education.	4.00	5.00
14. Consistency exists between exit standards for developmental math courses and entry standards for the college-level math courses.	4.00	4.00
15. Learning communities are used in developmental instruction.	3.50	3.00
16. Supplemental instruction, such as video-based and/or computer-based supplemental instruction is used to support developmental courses.	4.50	5.00
17. There are workshops provided on strategic thinking.	3.00	3.00
18. There is specific professional development provided on how to work with underprepared students.	2.50	2.00
19. There are ongoing student orientation courses.	3.00	4.00
20. Critical thinking is integrated into the developmental math curriculum.	4.00	4.00

Note. Table 2 shows the median score for each group of instructors.

At least two instructors from the developmental math program teach one college-level math class each, and two college-level math instructors have taught in the developmental math program within the last year. The two departments are in close proximity to each other and some of the instructors from both groups are friends outside of the college. There are lots of opportunities for interactions between the two groups of instructors.

After collecting the surveys, entering the data into an Excel spreadsheet, and calculating the median score, the data was summarized and displayed in tabular form. The researcher also reviewed the syllabi for each course, course descriptions, and college catalogs as a means of verifying, or triangulating, the data.

By calculating the median score and using the results in the following manner, it was possible to determine if the instructors felt that each component was being implemented within the program. The median was chosen as the measure of central tendency since this is an accepted practice of summarizing ordinal level data. For the convenience of this study, the researcher also noted that if the median is a 3 or less, then the instructors perceive that this component is not being implemented within the program. If the median score is above a 3, then the instructors perceive that this component is being implemented within the program. Overall, the instructors indicated that there was evidence of 18 out of the 20 items within the program at College A. Items 17 (the provision of workshops on strategic thinking) and 18 (the provision of professional development on working with underprepared students) were the two items that both groups felt were not very evident within the program. The researcher found no evidence either that any of these two items had been provided within the department at the college, although one of the math instructors had attended training at the Kellogg Institute in Boone, NC, which included training on working with underprepared students.

The developmental math instructors felt that 17 out of the 20 items were present as indicated by any score above 3.0. The developmental math instructors felt that items 17, 18, and 19 were not being implemented. These items deal with workshops on strategic thinking, the provision of professional development on working with underprepared students, and the provision of ongoing student orientation courses, respectively. The college-level math instructors indicated that they felt that 15 out of the 20 items were present. The college-level instructors also felt that items 17 and 18 were not very evident in the program along with items 2, 4, and 15. Items 2, 4, and 15 pertain to mastery learning, providing a variety of instructional methods, and the presence of learning communities. The researcher found little evidence that learning communities (15) were in place, which also reflected what the instructors indicated on their surveys. For component 19, the researcher did find evidence in the college catalogs of courses that dealt with study skills, motivation, goal setting, test taking, note taking, learning styles, effective learning techniques, etc. These courses are listed as ACA courses and each student is required to take at least one of these courses in order to obtain a 2-year degree from the college. However, students usually only take one course so it could not be said that they are *ongoing*.

Both groups of instructors indicated that components 1, 6, 9, 12, 13, and 16 were very evident within the program. These statements relate to how the program is set up, such as having clearly defined goals, a centralized and coordinated program, mandatory placement, integrated use of computer labs, college-wide commitment to developmental education, and the use of supplemental instruction. The researcher found evidence from other sources such as course descriptions, syllabi, interviews, and college catalogs that support these findings. There is a common syllabus for each level of math class, and each of the syllabi is similar with just changes in the learning outcomes for all three levels. As such, there is evidence in these syllabi showing that components 1, 3, 4, 7, 8, 12, 14, 16, and 20 are in place within the program. For example, 12 and 16 deal with the use of computer labs and supplemental instruction, respectively. According to the syllabi, each student is required to purchase an access kit which allows them to register for the online portion of the math material. All math classes have an online component to them and this material is an integral part of the course. The state competencies from which the learning outcomes are derived also show evidence of statements 1, 3, 5, 14, and 20. A review of the college catalogs yielded evidence to support that components 1, 6, 9, 10, 11, 13, 16, and 20 were in place.

Again, this list of components comes from 30 years of research by Hunter Boylan and D. Patrick Saxon on what works in remediation and is a suggested list of what should be included in a successful program. Recommendations for the developmental math program studied based on these results are described in Chapter 5.

Research Question 4: How is the developmental math program at the college being implemented? In an attempt to answer this question, the researcher collected data from several sources. The researcher surveyed students who were in the program at that time, students who had been in the program and had taken at least one college-level math class, developmental math instructors, and college-level math instructors. Another resource that was utilized was the online records from the North Carolina Community College System Office. The data from the two performance measures were summarized and displayed in tabular form. The two performance measures were the passing rates of the students in developmental courses, and the passing rates of former developmental students in subsequent college-level classes. In addition, the researcher also summarized the data from the Department of Institutional Effectiveness from the course evaluations for the 5 years prior to the study at College A.

All of the students who were placed into a developmental math class were placed there based on their scores from the placement test. The placement test is in a sense their first encounter with the developmental math program. Students are assigned to a MAT 060, MAT 070, MAT 080 class, or a college-level math class based on the results of this test. If a student scores within the retest range on the placement chart (Appendix D), he/she is permitted another chance to retake the placement test. Occasionally, there are students who feel as if they are misplaced into a particular class and they want to retake the placement test again. The current policy for allowing a retest in this case is that the student must make a grade of A in the current class, receive an instructor recommendation, and meet with the department chair who signs the paperwork allowing the retest. This policy was put into place in order to limit the number of students who were permitted to retake the placement test. Prior to the implementation of this policy, students were overwhelming the testing center with requests for retests. Many of the students seeking a retest were not within the retest range. The director of testing, in consultation with the chair of developmental education, came up with this policy in order to alleviate the problem of retesting. Since the college has a relatively small testing center with approximately 20 computers, it would be very difficult to retest everyone. The reason many of the students were placed into a developmental math class is that they scored poorly on the placement test. For many of these students, this test was the one chance they had to demonstrate their math ability. Since all of the students in the developmental math program took the placement test, it was important to determine their attitudes concerning this test. The students completed the Likert scale by indicating the number that best described their responses to each question using the following:

1 = Strongly Disagree

2 = Disagree

3 = No Opinion

4 = Agree

5 = Strongly Agree

Since the scores on the placement test are used to place students into either developmental math classes or college-level math classes, the researcher felt it important to gauge the students' opinions about the placement test.

Table 3

The Placement Test – Students' Opinions

Statement
The placement test placed me in the appropriate math class.

Current Developmental Math Students (n= 642)

Response	Frequency	Percent	Cumulative Percent
1	19	3.0	3.0
2	51	8.0	11.0
3	109	17.0	28.0
4	263	40.0	68.0
5	186	29.0	97.0
Missing	19	3.0	100.0
Total	642	100.0	

Former Developmental Math Students (n=148)

Response	Frequency	Percent	Cumulative Percent
1	15	10.0	10.0
2	24	16.0	26.0
3	21	14.0	40.0
4	71	48.0	88.0
5	16	11.0	99.0
Missing	1	0.06	100.0
Total	148	100.0	

Note. Table 3 shows the percentages for each group of students.

Table 3 displays the results of the survey question given to both the current developmental math students and former developmental math students regarding the placement test. In responding to the question of whether the students felt that they had been placed correctly into a developmental math class based on the placement test, 449 (69%) current developmental math students who took the survey and 87 (59%) former developmental math students who took the survey responded in a positive manner as indicated by a response of either a 4 or 5 on the Likert scale. In responding to the same question, 70 (11%) current developmental math students and 39 (26%) former developmental math students indicated that they felt that the placement test had not placed them in the correct developmental math class as indicated by a score of 1 or 2. There may be many reasons as to why these students felt that they had been misplaced, but the reasons were outside the scope of this study. Since many of the students will go on to take a college-level math class depending on the requirements of their program, the students were surveyed in order to determine if they felt that the program was doing a good job in helping them achieve that goal.

Table 4

Preparing Students for College-level Math – Students' Opinions

Statement
The developmental math program is doing (or did) a good job of preparing me for college-level math.

Current Developmental Math Students (n= 642)

Response	Frequency	Percent	Cumulative Percent
1	6	1.0	1.0
2	13	2.0	3.0
3	70	11.0	14.0
4	327	51.0	65.0
5	212	33.0	98.0
Missing	14	2.0	100.0
Total	642	100.0	

Former Developmental Math Students (n=148)

Response	Frequency	Percent	Cumulative Percent
1	15	10.0	10.0
2	24	16.0	26.0
3	21	14.0	40.0
4	71	48.0	88.0
5	16	11.0	99.0
Missing	1	0.7	100.0
Total	148	100.0	

Note. Table 4 shows the percentages for each group of students.

Both current developmental math students and former developmental math students were surveyed about their opinions on the developmental math program. When asked if they felt that the developmental math program was doing (or did) a good job of preparing them for college-level math, 539 (84%) current developmental math students and 87 (59%) former developmental students who were currently enrolled in a college-level math class responded in the affirmative with either a score of 4 or 5. This would indicate that the majority of students feel that the program is working to prepare them for college-level math. At the time the former developmental math students completed their surveys they had already experienced at least one college-level math class. This gave them a good sense of whether or not the developmental math program had indeed helped them prepare for college-level math. It appears as if the majority of them (59%) felt that the developmental math program did in fact help them. Only 19 (3%) current developmental math students and 39 (26%) former developmental math students responded in a negative manner by indicating a response of 1 or 2 on the survey. The reasons for the negative responses were outside the scope of this study. Further research is warranted as to why there was a difference of 25% (84%-59%) between current developmental math students and former developmental math students in their opinions as to how well the program was preparing students for college-level math.

Table 5

Overall Developmental Math Program –Students' Opinions

Statement
The developmental math program is doing a good job overall.

Current Developmental Math Students (n=642)			
Response	Frequency	Percent	Cumulative Percent
1	6	1.0	1.0
2	6	1.0	2.0
3	70	11.0	13.0
4	308	48.0	61.0
5	238	37.0	98.0
Missing	14	2.0	100.0
Total	642	100.0	

Former Developmental Math Students (n=148)			
Response	Frequency	Percent	Cumulative Percent
1	9	6.0	10.0
2	10	7.0	13.0
3	24	16.0	29.0
4	59	40.0	69.0
5	46	31.0	100.0
Missing	0	0.0	
Total	148	100.0	

Note. Table 5 shows the percentages for each group of students.

Not all students who take developmental math go on to take a college-level math class. Depending on their program, some students may only need one developmental math class. The math instructors also have to be available for students during office hours to assist students, to set up lab time so students can do their work on the computers, and to help students in other ways outside of the classroom. The students were surveyed to find out their opinions on the developmental math program even if they were not planning on taking a college-level math class. When asked if they felt as if the developmental math program was doing a good job overall, 546 (85%) current developmental math students and 105 (71%) former developmental math students indicated that they felt that the program was indeed doing a good job by scoring it with a 4 or 5 or the survey. There were 12 (2%) current developmental math students and 19 (13%) former developmental math students who felt that the program was not doing a good job overall as indicated by their scores of 1 or 2 on the survey. As a means of triangulating the data, the researcher reviewed the historical data from the student evaluations that were conducted over the past 5 years and found that the students did have a favorable opinion of the developmental math program overall. This will be discussed later on in this chapter in relation to Research Question 4.

Table 6

The Placement Test –Instructors' Opinions

Statement
The placement test places students into the appropriate math class.

Developmental Math Instructors (n=12)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	2	17.0	17.0
4	10	83.0	100.0
5	0	0.0	
Missing	0	0.0	
Total	12	100.0	

College-level Math Instructors (n=6)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	3	50.0	50.0
4	3	50.0	100.0
5	0	0.0	
Missing	0	0.0	
Total	6	100.0	

Note. Table 6 shows the percentages for each group of instructors.

When the same survey question was asked of the developmental math instructors and college-level math instructors regarding the placement test, the responses were as follows. On the question that asked if they felt that the placement test placed students correctly, 10 (83%) developmental math instructors and 3 (50%) college-level math instructors indicated a score of 4 (agree). None of the instructors from either group indicated a score of 1 or 2 in response to this question, but 2 (17%) developmental math instructors and 3 (50%) college-level math instructors indicated a score of 3 (no opinion) in response to this question. This is in contrast to the 11% of current developmental math students and 26% of former developmental math students who felt as if the placement test had not placed them in the correct math class. The reasons why these students felt that they had been incorrectly placed were not part of this particular study. It would appear that there are some differences in the opinions of the students and the instructors when it comes to the placement test.

Table 7

Preparing Students for College-level Math – Instructors' Opinions

Statement
The developmental math program is doing a good job of preparing students for college-level math.

Developmental Math Instructors (n=12)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	1	8.3	8.3
4	7	58.3	66.6
5	4	33.3	100.0
Missing	0	0.0	
Total	12	100.0	

College-level Math Instructors (n=6)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	0	0.0	0.0
4	5	83.3	83.3
5	1	16.7	100.0
Missing	0	0.0	
Total	6	100.0	

Note. Table 7 shows the percentages for each group of instructors.

Table 7 shows that 11 out of 12 developmental math instructors (91.7%) and all 6 (100%) college-level math instructors felt as if the developmental math program is doing a good job of preparing students for college-level math. Since one of the major goals of the developmental math program is to prepare students to take college-level math, it was very important to survey the college-level math instructors about this. These instructors get to teach those students who take developmental math classes prior to taking a college-level math class, and those students who test directly into college-level math classes. These instructors teach both groups of students in the same class. Based on the survey results, all of the college-level math instructors felt that the developmental math program was doing a good job of preparing students for college-level math. It is interesting to note, however, that 59% of the students felt as if the developmental math program had done a good job of preparing them for college-level math. Again, the reasons for the students' opinions on this survey question were not part of this particular study. As a way of triangulating the data from the surveys regarding this question, the researcher reviewed the historical data from the Department of Institutional Effectiveness. According to the Director of Institutional Effectiveness at College A, there was no statistical difference in the passing rates between the students who took developmental math prior to taking a college math course and those who placed directly into a college math course (R. Clay, personal communication, September 21, 2010). This data reinforces what college-level math instructors report experiencing in their classes.

Table 8

Overall Developmental Math Program – Instructors' Opinions

Statement
The developmental math program is doing a good job overall.

Developmental Math Instructors (n= 12)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	0	0.0	0.0
4	5	41.7	41.7
5	7	58.3	100.0
Missing	0	0.0	
Total	12	100.0	

College-level Math Instructors (n=6)

Response	Frequency	Percent	Cumulative Percent
1	0	0.0	0.0
2	0	0.0	0.0
3	0	0.0	0.0
4	4	66.7	66.7
5	2	33.3	100.0
Missing	0	0.0	
Total	6	100.0	

Note. Table 8 shows the percentages for each group of instructors.

When asked if they felt that the developmental math program was doing a good job overall, 100% of both groups responded with either a 4 or 5. All the instructors know that not every student who takes a developmental math class will need to take a college-level math class. For example, some students may only need MAT 070 for their program. The instructors also have to be available for students during office hours to assist students, to set up lab time so students can work on math problems on the computer, and to help students in other ways outside of the classroom. As indicated by the results in Table 8, all of the instructors from both groups felt that the program was doing a good job overall. Before completing the surveys, the instructors were reminded that their responses would be kept confidential, and that being honest would help to determine what, if anything, needed to be addressed within the developmental math department in order to make recommendations for improvement.

The overall progress of each student at the college is measured using a computer program by the Information Services Section of the North Carolina Community College System Office. This program provides grade information on students who successfully completed developmental courses and then took college-level courses. This program also provides grade information on students who enrolled in college-level courses without having been required to take developmental courses. This historical data is available at the college from the Department of Institutional Effectiveness and from the Internet. Currently, the state standards are that 75% or more of developmental math students will receive a grade of C or better, and that 80% of former developmental math students who go on to take college-level math classes will receive a grade of C or better.

Table 9

State Performance Measures of Developmental Math Students

School Year	Passing Rates of Students in Developmental Math at College A	Passing Rates of Developmental Students in Subsequent College-Level Courses at College A
2004-2005	78% (N=1822)	88% (N=531)
2005-2006	81% (N=1802)	87% (N=688)
2006-2007	77% (N=1411)	90% (N=223)
2007-2008	82% (N=1625)	89% (N=303)
2008-2009	81% (N=1882)	89% (N=402)

Note. Table 9 shows the passing rates of developmental math students by academic year.

This historical data was examined to determine the overall effectiveness of the developmental math program over the past 5 years in meeting the two state standards of passing rates and performance in subsequent college-level math classes. According to the data displayed in Table 9, the target college exceeded the state standards on these passing rates for the years that were reviewed. As mentioned earlier, the instructors for college-level math classes indicated on their surveys that the developmental math program was doing a good job or preparing students for college-level math. Both the information from the instructors and the data on passing rates appear to be in agreement.

At the end of each semester, the students are given course evaluations to complete. These evaluations are collected and sent to the Office of Institutional Effectiveness. The data from these surveys are then analyzed with the results being available in tabular form. The data is collected in the fall semester and spring semester and displayed separately as such. The evaluations are not carried out for the summer semester. A sample of the evaluations is shown in Appendix M. The students use a bubble-in Likert scale to indicate their response to each question. The overall scores from each program are shown as a mean score with 4.0 being the maximum score possible.

Table 10

Summary of Course Evaluations

	Developmental Education Department	Number of programs evaluated	Range of scores for all programs
2006	3.7	29	3.3 – 3.9
2007	3.6	35	3.4 – 3.9
2008	3.6	32	3.4 – 3.9
2009	3.6	28	3.4 – 3.9
2010 Spring	3.6	31	3.4 – 3.9

Note. Table 10 shows the mean scores with 4.0 being the maximum score possible.

These evaluations are sent to the Department of Institutional Effectiveness which in turn compiles the data based on the results of these evaluations. The researcher found that over the last 5 years (dating back to 2006 up to the spring of 2010), the developmental education department consistently had a mean score in the 3.6 range where the maximum score is a 4.0. This would appear to indicate a high degree of satisfaction among the students with this department which, in turn, would substantiate what the researcher found within student survey results.

Research Question 5: How effective is the developmental math program at the college? In order to include a control group as part of this study, the researcher tried to include those students who had taken the placement test but who had not taken a developmental math class since then. The researcher obtained a list of approximately 200 students who met these criteria and attempted to include as many of these students as possible. The researcher emailed and telephoned everyone on the list, and followed up with a second email, but only managed to get 17 students who were willing to participate in this study. Out of these 17 students, 13 of them had useable arithmetic scores and four had useable algebra scores. The researcher recognizes that this was a small control group which may or may not be indicative of all the students who had not taken a math class since taking the placement test. This limitation was noted elsewhere in the study. If the student did not take a developmental math class since taking the placement test, then they were in the group referred to as the no treatment group. If the student had taken a math class since taking the placement test, they were in the group referred to as the treatment group. The results of the overall test data from these students are in Table 11.

Using the SPSS software, the researcher conducted Analysis of Variance (ANOVA) tests and two different types of *t*-tests (an independent *t*-test in order to compare the pretest scores from the treatment group with those of the control group, and a dependent *t*-test to compare the scores within each subgroup of gender, age, and ethnicity). ANOVA tests are used when comparing two, three, or more means to determine whether or not these means are equal. The data from these ANOVA tests and other *t*-tests are included in this chapter. For all *t*-tests, significance was compared to alpha = .05. All statistical testing was done using SPSS 18.0 software.

Upon taking the original placement test (pretest), students could have an arithmetic (pre-algebra) score and/or an algebra score. At the end of the semester, these students were retested again using the same placement test (posttest). Students earned an arithmetic score and/or an algebra score depending on how well they did. The data for the arithmetic scores are presented first, followed by the data from the algebra scores.

There was not a significant difference between the means of the treatment group (those who took a developmental math class) and the means of the control group (those who did not take a math class) on the pretest (t(429 = .2), p = 0.8) This confirms the random sample design for the data collected. The data in the following tables have been rounded to the nearest tenth for convenience.

Table 11

Overall Comparisons of Pretest and Posttest Data for Arithmetic Scores

	Pretest Arithmetic Scores (n = 417)	Posttest Arithmetic Scores (n = 417)	Increase (M_{diff})
Overall sample of those who experienced the program (the treatment group)	39.6	48.9	9.3
SD (standard deviation)	14.5	14.6	
	Pretest Arithmetic Scores (n = 13)	Posttest Arithmetic Scores (n = 13)	Increase
Overall sample of those who did not take a math course (control group)	38.8	43.5	4.7
SD	20.2	18.7	

Note. Table 11 shows the mean scores.

The dependent *t*-test found a mean difference of 9.3 points (M_{diff} = 9.3, t(416)=11.2, p < .0001, (95% CI): 7.6 – 10.9, implying that there was an increase of 9.3 points from the time the students took the pretest until they took the posttest for those who experienced the program (treatment group). Mean differences were found by subtracting the mean score on the pretest from the mean score on the posttest. The student's *t*-test value of 11.2 indicates significant differences where a high test statistic (*t* value) implies that the difference in the scores is not from chance alone. A large *t*-value translates into $p < .0001$, again indicating that the mean difference is significant. Therefore, the mean difference is statistically significant and could not have occurred by chance alone. The confidence interval of 95% means that we are 95% confident that the true population mean difference falls somewhere between the two reported values, which in this case are 7.6 and 10.9.

For those who did not take a developmental math course (control group), the dependent *t*-test showed an $M_{diff} = 0.54$, $t(12) = .2$, $p = .8$, (95% CI): -6.3 – 5.24. A $p < .05$ is considered statistically significant. Since the p-value here is greater than .05, the gains in this group were not statistically significant.

Based on this data, the researcher concluded that there were significant gains in the arithmetic scores for those students who experienced the program, and no significant gains for those in the control group.

As mentioned earlier, students were given a placement test when they first came to the college. This test was referred to as the pretest in this study. After having experienced the program, the students were again given the same test, and this test was then referred to as the posttest. The basic assumption was that if the developmental math program was doing what it was intended to do, then there would be an increase in test scores after the students had experienced the program. Indeed, in every category that the researcher looked at, the test scores did increase. Overall there were 642 students who attempted to take the posttest. This represented approximately 50% of the students in the developmental math program at that time. Out of the 642 students who attempted to take the posttest, there were some students who did not complete the test due to lack of time, computer problems, or other reasons. Out of the 642 students who attempted to take the posttest, 417 had an arithmetic score and 183 had an algebra score. One of the limitations of the study is that the students may have only been given one pretest score (either an arithmetic score or an algebra score) and one posttest score. Other students were given two pretest scores (both an arithmetic score and an algebra score) and two posttest scores (again an arithmetic score and an algebra score). In still other cases, some students were given one score on the pretest, but had two scores on the posttest. Whether they earned one or two scores depended on how well they did on these tests. By having just one score on the pretest (usually an arithmetic score), the student scored low on the pretest and did not receive an algebra score. After having experienced the program, these students improved their scores so much that they now had both an arithmetic score and an algebra score on the posttest. This did not cause problems for the researcher when looking at large portions of the data such as overall scores or when comparing scores of males and females. When looking at a more detailed analysis of the data, the researcher found that there were some students who did not have a score on the algebra pretest, but who then had a score on the algebra posttest, and vice versa. This was a result of having scored so well on the posttest that they now had an algebra score. This reduced the number of students in some of the subgroups as the researcher was only comparing the means of students from pretest to posttest who had scores on both tests. After consulting with a statistics professor and the director of the Department of Institutional Effectiveness at the college, the researcher concluded that this would not be a major problem since it was the means from dependent *t*-tests that were being reported. Again, this was one of the limitations of the study as noted earlier.

A further breakdown was necessary in order to compare the scores of males and females from the pretest and the posttest in both the arithmetic tests and algebra tests.

Table 12

Pretest and Posttest Data for Males and Females with Arithmetic Scores

	Pretest Arithmetic Scores	Posttest Arithmetic Scores	Increase
Males	42.5 (n = 164)	50.5 (n = 164)	8.0
SD	16.3	15.3	
Females	37.7 (n=253)	47.7 (n=253)	10.0
SD	12.8	14.0	

Note. Table 12 shows the mean scores.

The output from SPSS for males showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 8.0, t(163)=5.83, $p < .0001$, (95% CI): 5.3 – 10.7). There was an increase of 8.0 points from the time the students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for females showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 10.0, t(252)=9.72, $p < .0001$, (95% CI): 8.0 – 12.1). There was an increase of 10.0 points from the time the female students took the pretest until they took the posttest for those who experienced the program (treatment group). There was no significant difference found between the means of males and females in their arithmetic scores. Based on the data, the researcher concluded that both the males and females were benefitting from the developmental math program. It must be noted that, on average, the gains for females in the arithmetic scores were two points greater than the gains for males.

Table 13

Pretest and Posttest Data for Different Age Groups with Arithmetic Scores

Age Group	Pretest Arithmetic Scores	Posttest Arithmetic Scores	Increase
25 and under	40.3 (n=155)	48.4 (n=155)	8.1
SD	13.3	13.6	
26 to 35	40.9 (n=91)	53.3 (n=91)	12.4
SD	15.7	15.5	
36 and above	38.3 (n=171)	46.9 (n=171)	8.6
SD	14.8	14.4	

Note. Table 13 shows the mean score for each age group.

The researcher also examined the data for three different age groups. The age groups are the same age groups that the college uses in its reports. The age groups are 25 and under, 26 to 35, and 36 and above, based on their age at their last birthday.

The dependent *t*-test for the 25 and under age group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 8.1, $t(154)=7.4$, $p < .0001$, (95% CI): 5.9 – 10.3). There was a statistically significant increase of 8.1 points from the time this group of students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for the 26 to 35 age group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 12.45, t(90)=6.32, p < .0001,(95% CI): 8.4-16.4). There was a statistically significant increase of 12.45 points from the time this group of students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for the 36 and over age group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 8.6, t(170)=6.13, p < .001, (95% CI): 5.9 – 11.4). There was a statistically significant increase of 8.6 points from the time this group of students took the pretest until they took the posttest for those who experienced the program (treatment group).

According to the data, those in the 26 to 35 age group made the largest gains on average from pretest to posttest (12.4 points) on the arithmetic portion of the test. The 36 and over age group made the next largest gains (8.6 points) followed by the 25 and under age group (8.1 points). Another interesting point from the data is that the 25 and under age group and the 26 to 35 age group started out with similar mean scores (40.3 and 40.9, respectively) on the pretest, but the 26 to 35 age group made larger gains on average between pretest and posttest. The 36 and over age group started out with a lower mean score than the other two age groups on the pretest, and ended up with a lower mean score on the posttest. The reasons for this are outside the scope of this study.

The ANOVA test found no mean differences by age group in the arithmetic scores (F(2, 414)=2.12, p=.1218).

Table 14

Pretest and Posttest Data for the Different Ethnicities with Arithmetic Scores

Ethnicity	Pretest Arithmetic Scores	Posttest Arithmetic Scores	Increase
White	40.5 (n=303)	50.6 (n=303)	10.1
SD	15.2	14.6	
Black	36.1 (n=84)	41.8 (n=84)	5.7
SD	10.8	11.3	
Hispanic	43.0 (n=18)	53.8 (n=18)	10.8
SD	17.5	17.8	

Note. Table 14 shows the mean scores.

The dependent *t*-test for the White subgroup showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 10.1, t(302)=10.06, p < .001,(95% CI): 8.1-12.1). There was a statistically significant increase of 10.1 points from the time this ethnic group of students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for the Black subgroup showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 5.7, t(83)=3.59, p < .001, (95% CI): 2.5-8.8). There was a statistically significant increase of 5.7 points from the time this ethnic group of students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for the Hispanic subgroup showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 10.8, $t(17)=2.43$, $p < .003$, (95% CI): 1.4-20.5). There was a statistically significant increase of 10.8 points from the time this ethnic group of students took the pretest until they took the posttest for those who experienced the program (treatment group). The mean scores for each ethnic group increased between the pretest and posttest.

According to the data, Hispanics had the highest mean score on the arithmetic pretest followed by Whites and then Blacks. After experiencing the program, Hispanics made the largest gains on average, followed by Whites and then Blacks.

Based on the analysis of the data for the sample population, the analysis by gender, age groups, and ethnicity, it is evident that the developmental math program was effective in improving the math scores for these groups. While there may have been some individual students who had a decrease in their scores from pretest to posttest, the reasons for this were outside this study. Further research would be needed in order to determine the reason or reasons for these decreases.

The ANOVA test found no mean differences by race in the arithmetic scores ($F(3, 413)=1.6$, $p=0.1829$).

Table 15

Overall Comparisons of Pretest and Posttest Data for Algebra Scores

	Pretest Algebra Scores (n = 183)	Posttest Algebra Scores (n = 183)	Increase
Overall sample of those who took a math course (treatment group)	34.8	43.9	9.1
SD	8.0	17.1	
	Pretest Algebra Scores (n = 4)	Posttest Algebra Scores (n = 4)	Increase
Overall sample of those who did not take a math course (control group)	29.5	32.9	3.4
SD	3.7	1.8	

Note. Table 15 shows the mean scores.

The dependent *t*-test for the overall sample for the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 9.1, t(182)=7.68, p < .001, (95% CI): 7.0 – 11.9). There was an increase of 9.1 points from the time the students took the pretest until they took the posttest for those who experienced the program (treatment group).

The dependent *t*-test for the overall sample for the control group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 3.4, t(3)=7.68, p = .4, (95% CI): -15.79 – 8.8). Unfortunately, there was a small sample size of students in the control group who had both an algebra score on the pretest and the posttest. While stating that there were no significant gains for those in the control group, it must also be stated that the sample size was limited to four students.

Based on the data, the researcher concluded that there were significant gains in the algebra scores for the overall sample for those who experienced the program, but there were no significant gains for the control group.

Table 16

Pretest and Posttest Data for Males and Females with Algebra Scores

	Pretest Algebra Scores	Posttest Algebra Scores	Increase
Males	33.4 (n = 88)	42.9 (n = 88)	9.5
SD	7.0	18.8	
Females	36.1 (n=95)	44.9 (n=95)	8.8
SD	12.8	14.0	

Note. Table 16 shows the mean scores.

The dependent *t*-test for males in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 9.5, t(87)=4.8, p < .001, (95% CI): 5.6-13.5). There was a statistically significant gain in the algebra scores for males who experienced the program.

The dependent *t*-test for the females showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 8.8, t(94)=6, p < .001, (95% CI): 5.9-11.8). There was a statistically significant gain in the algebra scores for females who experienced the program. It is interesting to note here that the gains from pretest to posttest for males on the algebra portion of the test were slightly higher on average (0.7 points) than the gains for females. This is the opposite of what occurred on the arithmetic portion of the test where females had slightly higher gains on average. The reason, or reasons, for this were not part of the study.

Table 17

Pretest and Posttest Data for Different Age Groups with Algebra Scores

Age Group	Pretest Algebra Scores	Posttest Algebra Scores	Increase
25 and under	35.0 (n=144)	43.3 (n=144)	8.3
SD	8.0	16.8	
26 to 35	33.7 (n=20)	53.1 (n=20)	19.4
SD	8.1	19.1	
36 and above	34.3 (n=19)	39.4 (n=19)	5.1
SD	8.8	14.2	

Note. Table 17 shows the mean scores.

The dependent *t*-test for the 25 and under age group in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 8.3, t(143)=4.8, p < .001, (95% CI): 5.7-10.9). There was a statistically significant gain in the algebra scores for those students 25 and under who experienced the program.

The dependent *t*-test for the 26 to35 age group in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 19.4, t(19)=4.2, p < .001, (95% CI): 9.8-29.1). There was a statistically significant gain in the algebra scores for those students in the 26 to 35 age group who experienced the program.

The dependent *t*-test for the 36 and over age group in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 5.1, t(18)=1.4, p = .2, (95% CI): -2.4-12.5). There was no statistically significant gain in the algebra scores for those students in the 36 and over age group who experienced the program.

The ANOVA test found mean differences by age group in the algebra scores (F(2, 180)=4.87, p=.0087). Pair-wise comparisons were performed using the Scheffe adjustment in order to control for the Type I error rate. The 26-35 age group had significantly higher gains on the algebra scores than did the 25 and under age group (M_{diff} = 11.2, p < .001) and the 36 and over age group (M_{diff} = 14.4, p < .001). No other significant mean differences were found for the age groups. This implies that those in the 26-35 age group gained 11.2 points more on average than those in the 25 and under age group, and gained 14.4 points more on average than those in the 36 and over age group on the algebra portion. The reason, or reasons, for this are outside the scope of this study, but further research on these differences may yield valuable insights.

Table 18

Pretest and Posttest Data for Different Ethnicities with Algebra Scores

Ethnicity	Pretest Algebra Scores	Posttest Algebra Scores	Increase
White	34.8 (n=154)	44.1 (n=154)	9.3
SD	8.0	16.0	
Black	34.4 (n=20)	40.0 (n=20)	5.6
SD	8.0	12.0	
Hispanic	40.0 (n=3)	55 (n=3)	15.0
SD	19.1	23.0	

Note. Table 18 shows the mean scores.

The dependent *t*-test for the White subgroup in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 9.3, t(153)=6.8, p < .001, (95% CI): 6.6-12.0). There was a statistically significant gain in the algebra scores for those students in the White subgroup who experienced the program.

The dependent *t*-test for the Black subgroup in the treatment group showed that the developmental math program contributed to increases in scores on the placement test (M_{diff} = 5.6, t(19)=1.9, p < .08,(95% CI): -0.8-12.1). There was not a statistically significant gain in the algebra scores for those students in the Black subgroup who experienced the program.

The dependent *t*-test for the Hispanic subgroup in the treatment group showed that the developmental math program contributed to increases in scores on the placement test

(M_{diff} = 15.0, $t(2)=3.7$, $p < .07$,(95% CI): -2.8-32.4). There was a statistically significant gain in the algebra scores for those students in the Hispanic subgroup who experienced the program. Again, caution should be taken as the sample size was small (3 students), and true gains in the population may not be reflected in this small sample size.

The ANOVA test found no mean differences by race for the algebra scores ($F(3, 179) = 0.59$, $p=0.6236$).

Summary

In an attempt to answer the five research questions, the researcher has presented the data that was collected in the course of this study. By taking each research question separately, displaying the data, narrating the data and the results, and then finding ways to triangulate the data, the researcher answered the five research questions presented. For Research Question 1, "what are the conditions leading to the necessity of a developmental mathematics program at the college level," the researcher showed that there has always been a need for some form of remediation at the college, and that the college has been following state policy on placing students into classes based on their placement scores. Some students came to the college needing remediation in order to get them ready for college-level courses. The college has always attempted to offer assistance to these students. Over time, the students were placed into developmental classes based on placement scores determined by the state. The college has been following the state policy of placing students based on these scores. For Research Question 2, "what other attempts have been made to solve the problem," the researcher found evidence of other programs that were in place at the college over the years, and programs that were still in place in order to help students. For Research Question 3, "how does the implementation of the developmental math program at the college align with recommendations for appropriate instruction of developmental math students," the researcher took a list of 20 items that were deemed to be important to a successful program and included them in the instructors' interviews. This list was compiled by researchers at the National Center for Developmental Education in Boone, North Carolina. Based on the results of the data collected from this list, the instructors indicated that as many as 18 out of 20 items were in place at College A. Items 17 (the provision of workshops on strategic thinking) and 18 (the provision of professional development on working with underprepared students) were the two items that both groups felt were not very evident within the program. This would appear to show that the program was well designed and contained much of the essential items needed for a successful program. For Research Question 4, "how is the developmental math program at the college being implemented," the researcher surveyed developmental math students and former developmental math students, interviewed developmental math instructors and college-level math instructors, and analyzed the data in answering this research question. It is evident from the data that a majority of the respondents felt that the program was doing a good job both in preparing students for college-level math, and in doing a good job overall. As a means of triangulating the results of the surveys, the researcher included data from the Department of Institutional Effectiveness. Based on this other data source, students from the past 5 years indicated a high level of satisfaction with the program by consistently scoring it with a 3.6 out of a 4.0 on the course evaluations. For Research Question 5, "how effective is the developmental math program at the college," the researcher collected the data from the placement scores and conducted posttests. Surveys were included as part of the posttests. The researcher also included a control group for comparison purposes. The data was analyzed and the results indicated that the program appeared to be helping students improve their math scores. The researcher looked at the arithmetic scores and the algebra scores separately, conducted the data analysis separately, and discussed the results separately. The researcher also looked at the subgroups of gender, age, and ethnicity, and found that the developmental math was helping all of the subgroups improve their math scores.

For the arithmetic scores, the ANOVA found no mean differences in any of the subgroups of gender, ethnicity, or age groups. It does appear the females were benefitting, on average, by two points more than males on the arithmetic portion of the test, but this was not found to be statistically significant.

For the algebra scores, the ANOVA found mean differences in the age categories. The 26-35 age group on average gained 11.2 points more than those in the 25 and under age group, and 14.4 points more than those in the 36 and over age group. There were no mean differences found in the subgroups of gender or race. It does appear the males were benefitting, on average, by 0.7 points more than females on the algebra portion of the test, but this difference is not significantly significant. Therefore, it appears as if males and females were benefitting equally from the developmental math program on the algebra portion.

The ANOVA found no mean differences by ethnicity for the algebra scores. Further data analysis for the ethnicities of White, Black, and Hispanic found that the average gains for Whites and Hispanics were statistically significant, but were not statistically significant for Blacks. This area may also need further study as the sample sizes for Blacks and Hispanics were small and may or may not be indicative of the population.

The researcher has answered all of the research questions using the CIPP model as a guide for this study by gathering information from a variety of sources, surveying students and instructors, collecting and analyzing the data, and presenting the findings. In Chapter 5, the researcher presents recommendations and conclusions based on the data analysis and discussions detailed in this chapter. The recommendations are based on the findings discussed in this chapter.

Chapter 5: Discussions, Conclusions, and Recommendations

Introduction

Using the CIPP model as a guide, this study served as a program evaluation of a developmental math program at the college level. This was the first time that a program evaluation was conducted on the developmental math program at this college. The researcher employed five research questions to guide the study and they were:

1. What are the conditions leading to the necessity of a developmental mathematics program at the college level?
2. What other attempts have been made to solve the problem?
3. How does the implementation of the developmental math program at the college align with recommendations for appropriate instruction of developmental math students?
4. How is the developmental math program at the college being implemented?
5. How effective is the developmental math program at the college?

Both qualitative and quantitative methods were used to examine the context, input, process, and product components of the program. These measures included surveys, interviews, document reviews, test scores, placement scores, reviewing college catalogs and historical records, and institutional data. The results, including the data analysis, of these measures were presented in Chapter 4. The recommendations based on the results of the data analysis are discussed in this chapter. Each research question is discussed separately and presented in numerical order.

Research Questions

Research Question 1: What are the conditions leading to the necessity of a developmental mathematics program at the college level? Whether or not a student takes a developmental math course is based on his/her placement score. If a student falls below a certain cut score (a 99 or below on the arithmetic score, or a 65 or below on the algebra score), then that student must take a developmental class according to the placement chart in Appendix D. These cut scores are part of the state policy of having a standard method of placing students either into or out of developmental math classes. The same policy applies to the areas of reading and English placement also.

Given that between 20% and 40% of students each year have to take one or more developmental courses at the target college, there is a definite need for a developmental education department in order to help these students be successful at the college level. According to the literature review, without such help many of these students would not succeed at the college level. The only method of determining if a student must take a developmental math class is through the placement test. This places a lot of pressure on a student to do well on the placement test as it is used to determine if he/she must take a developmental class, which in turn could add a year or more to the student's time at the college. Since this is such a high-stakes test, it is recommended that a study be conducted to determine if there is any alignment between the placement test, what is taught in the various courses, and the final exams. The researcher found no evidence that such a study had been conducted at the college. Based on the results of the students' surveys, 11% of current developmental math students and 26% of former developmental math students felt that they had not been placed correctly according to the placement test. A student should also have the opportunity to retake the placement test regardless of whether or not he/she is within the retest range. Retesting should be easily accessible to all students. Currently, the policy on retesting is that a student must be within a certain retest range. If a student was ill on the day of the test, or had another valid reason to ask for a retest, the student must contact the chair of developmental education in order to get permission to retest. There are not enough computers available in the testing center to accommodate all the retesting that might be needed, but the college may need to consider allowing retesting in other computer labs across campus. Currently there is only one person on each campus who is trained to administer the placement test. Having more staff trained to administer the placement test at several locations would make the test more accessible for retesting purposes.

It is also suggested that other methods should be used in determining placement. For example, grades in high school math classes should be considered, in particular the scores on the state tests for algebra I, algebra II, and geometry since these are the most common math classes for students to take in high school. The researcher further suggests that since the COMPASS® test is used to place a student into a developmental class, it is recommended that the same test, or another designed for placement purposes, be used to determine if the student is ready to exit the course. This would mean that the student would retake the placement test again at the end of the course. This is currently not being done as the testing center has approximately 20 computers and one staff member which would not be enough to accommodate all the students who would need retesting. Again, other computer labs across campus could be used to accommodate the retesting.

Research Question 2: What other attempts have been made to solve the problem? Over the years, it appears as if there have been several attempts made to solve the problem. According to the college catalogs from the 1960s, the college did offer some form of remediation for students who needed it. While remediation was not required, the students were *advised* to take remedial classes if their tests scores indicated a need. It appears as if the instructors for math and English may have offered tutoring on an as-needed basis. Then in 1982, the college created a more formal system and named it the Developmental Education Program. There appears to have been a small Developmental Education Learning Center available at this time also as it is mentioned within other documents. This center was staffed with one part-time coordinator and several tutors. In 1996, the college established a Learning Center in order to help students in a more formal and coordinated way, and it was staffed by a full-time coordinator and several tutors. In January of 1998, the Learning Center moved into a newly renovated building where it is still located at the present time. The Learning Center is made up of many different parts. It has a computer lab where students can use the computers to do their work, get assistance with online work, watch DVDs, and receive help from a trained tutor. There is also a peer-tutoring center whereby students can receive help from tutors in a particular subject. These tutors are students who have demonstrated a certain mastery of the subject in which they are tutoring. They undergo a training session in the Learning Center before they begin to tutor. Students who need assistance in a certain subject are encouraged to come by the Learning Center and sign up for free tutoring. The tutors work one-on-one with each student usually for about an hour at a time and up to 3 hours per week.

There is also a resource center located in the Learning Center where students may come by and avail of such materials as handouts, DVDs, books, videos, etc.

From the evidence presented within this study, it appears as if the college has made several attempts to solve, or at least help with, the problem. The researcher suggests that the current methods of assistance should continue to operate as there is a large demand for such assistance.

Research Question 3: How does the implementation of the developmental

math program at the college align with recommendations for appropriate instruction of developmental math students? Based on the survey results discussed in Chapter 4, the researcher would recommend providing some professional development in the area of working with underprepared students and on strategic thinking. Currently, the best model on strategic learning is designed by Claire Weinstein at the University of Texas in Austin. This model includes four major components (Weinstein et al., 1998). It focuses on the areas of skill, will, self-regulation, and academic environment. In the area of skill, the student learns how to use learning strategies and to identify important information in the lesson. In the area of skill, the student learns how to set goals and how to maintain motivation. For self-regulation, the student learns about time management and understanding content. In the fourth area of academic environment, the student learns about teacher expectations and task characteristics. The college has partnered with an organization called Pacific Crest which provides much of the professional development on site at the college. The instructors make a request to the contact person on campus asking for professional development on a particular subject, and then this company provides it. My recommendation is that the college requests some professional development on strategic thinking to be held at the college.

In order to address the need for training on working with underprepared students, there is a training and certification program called the Kellogg Institute that is conducted during the summer at the National Center for Developmental Education in Boone, NC. This training is regarded as the premier training in developmental education. In order to receive the training, the instructors would have to travel to that location, and it is expensive. The 2011 application lists the institute fee as approximately $1,500 per person with approximately another $1,000 if room and board is needed. Another way of providing the training would be to have an expert in the field come to the college and conduct some workshops. Since this is a specialized area, it would need to be someone who is experienced in working with students in developmental education. D. Patrick Saxon from the National Center for Developmental Education has indicated that the Center is willing to open a dialogue in providing the training. Having the training at the target college at a time that is convenient for the instructors may result in more instructors availing of the training. Another option for this training would be to use the *train the trainer* model. One instructor would attend the Kellogg training and then share the training with the other instructors when he/she returns to the college. This model has been used before in other areas at the college. The downside to this model is that only the person who attends the actual training in Boone will be awarded a certificate. The person who goes to the training must be prepared to share the information with the other instructors upon returning to the college. A fourth option would be to contact Pacific Crest to find out if they have anyone qualified to provide this training.

Research Question 4: How is the developmental math program at the college being implemented? Based on the data presented in Chapter 4, it appears as if the majority of the current developmental math students (69%) and former developmental math students (59%) who completed the surveys indicated that they felt as if they had been placed correctly based on their placement scores. However, 11% of the current developmental math students and 26% of former developmental math students expressed the opinion that they had not been correctly placed. It is recommended that there should be other factors used to determine the placement of the student into a math class such as high school transcripts and/or a math diagnostic test that pinpoints the math deficiencies. There should also be an opportunity for students to take refresher courses before taking the placement test. These could be offered during the summer as self-supporting mini courses lasting 2 weeks. Another option would be to have an online practice test that prospective students could review online before they take the actual placement test. As mentioned earlier, students also should have several opportunities to retake the placement test. Currently, a student can retake the placement test if he/she scores within the retest range. If the student does not score within the retest range, he/she must get special permission from the chair of developmental education in order to retest. The researcher recommends that students should have several opportunities to retest. This would involve having the software loaded in several computer labs, and having more people trained to administer the test. Students have mentioned that they did not take the test seriously, they were there to fill in an application and just took the test out of convenience, they felt rushed that day (even though the test is untimed), they did not know that they could use a calculator on the test, they felt unwell that day, they did not understand that this test would be used to place them in or out of developmental math and the consequences of that placement, they had not had any math in several years, and they genuinely felt that they should have done much better. The researcher did not find any evidence of a study showing the accuracy of the placement test, or that there is a relationship between what is taught in the different levels of developmental math and the placement test. Allowing students to retest will address some of these concerns.

When asked if they felt the developmental math program was doing a good job in preparing (or had prepared) them for college-level math, 84% of current developmental math students and 59% of former developmental math students responded in a positive manner with either a score of 4 or 5. It is interesting to note that the percentage dropped from 84% to 59% for those who were experiencing the program to those who had gone on to take at least a college-level math class. This is a drop of 25% in the number of students who responded with either a 4 or 5 on this survey question. Also, 26% of former developmental math students who had taken at least one college-level math class responded in a negative manner by indicating a score of 1 or 2 on the survey. Further research is suggested in this area in order to determine the reason, or reasons, why these students felt this way. Knowing some of the reasons why students' opinions of the developmental program changed after they took a college-level math class would be important feedback for the department to have in order to work on improving the program.

Based on the data from the developmental math instructors and college-level math instructors, the opinions from both groups are similar on all three questions. Regarding the question about the placement test and if it places students correctly, the developmental math instructors responded with a 3, no opinion (17%), or a 4, agree (83%). For the college-level math instructors, 50% responded with a 3, no opinion, and 50% with a 4, agree. No instructor from either group felt that the placement test placed students incorrectly. Based on these responses, it appears as if the placement test is working for the majority of students by placing them correctly. However, instructors have mentioned that they see a small number of students each semester who, after some math review, are able to remember a lot of the math that they needed for the placement test. These students learned the math in high school but it had been years since they had any math. They did not review before they took the placement test. When they did get some math review in class, they started to remember more and more of it. The instructors felt that if these students had reviewed before they took the placement test, then their scores would have been higher. Again, this is for a small number of students which the researcher estimates to be about two out of every 100 students. The instructors are trying to help every student, so they are supportive of allowing retests for students even if retesting may only benefit a small number of these students.

When asked if they felt that the developmental math program was doing a good job of preparing students for college-level math, both groups responded in a positive way. In fact, the college-level math instructors gave higher responses to this question than the developmental math instructors (100% for college-level instructors and 91.6% for developmental math instructors). On the last question, both groups also felt that the developmental math program was doing a good job overall with 100% of both groups responding with either a 4 or a 5. There were no negative responses to this question. Based on these responses, it appears as if the developmental program is doing a good job and that no major recommendations are suggested at this time.

Research Question 5: How effective is the developmental math program at the college? According to the data collected and analyzed, it appears as if the program is doing an effective job at improving the arithmetic test scores of students. For the overall group of those who experienced the program, the scores in arithmetic increased from pretest to posttest as indicated by the dependent *t*-tests and p-values. In every subgroup of gender, age, and ethnicity, the scores increased from the time the students took the pretest until the time they took the posttest and these increases were deemed to be statistically significant. There was a very small control group of 13 students who have not taken any math classes since they took the pretest. Upon taking the retest, their arithmetic scores did not show any significant statistical increase.

Based on the data, it appears as if all the subgroups are benefitting from the developmental math program. There were a small number of students whose scores decreased from pretest to posttest. Further research in this area is suggested in order to determine why their scores dropped. The reasons why the scores dropped are outside the scope of this study.

The scores for males and females were not found to have any statistical difference according to the dependent *t*-tests that were carried out. The scores for males increased by an average of 8.0 points for those in the treatment group (M_{diff} = 8.0, t(163)=5.83, p < .0001, (95% CI): 5.3 – 10.7). The dependent *t*-test for females showed that the developmental math program contributed to increases in scores of 10.0 points on average on the placement test (M_{diff} = 10.0, t(252)=9.72, p < .0001, (95% CI): 8.0 – 12.1). While it appears as if females are gaining two points more than males from pretest to posttest, this was not found to be statistically significant. In the case of age groups, the ANOVA test found no mean differences in the arithmetic scores (F(2, 414)=2.12, p=.1218). According to the dependent *t*-tests, the 25 and under age group gained 8.1 points, the 26 to 35 age group gained 12.4 points, and the 36 and over age group gained 8.6 points on average in their arithmetic scores. It appears as if the 26 to 35 age group gained the most, followed by the 36 and over age group, and then the 25 and under age group. While it appears as if each group increased by different amounts, the ANOVA test found no mean differences by age group in the arithmetic scores (F(2, 414)=2.12, p=.1218). Based on this data analysis, the researcher does not recommend any changes to the program in the arithmetic portion of the program in the area of age groups.

Next the researcher examined data from the different ethnic groups. From the data analysis by dependent *t*-tests, it appears as if the scores of Hispanics increased the most by 10.8 points, followed by Whites with 10.1 points, and then Blacks with 5.7 points. While there are apparent differences in the gains made by each ethnic group, the

ANOVA test did not find the differences to be statistically significant in the area of arithmetic scores ($F(3, 413)=1.6$, $p=0.1829$). Based on the data analysis, the researcher is not suggesting that any changes be made to the developmental math program in the area of arithmetic instruction at this time.

Next the researcher analyzed the algebra scores. For the overall group of those who experienced the program, the scores in algebra increased from pretest to posttest as indicated by the dependent *t*-tests and p-values. In the subgroups of gender and ethnicity, the scores increased from the time the students took the pretest until the time they took the posttest and these increases were deemed to be statistically significant. The gains within these groups were not statistically significant from each other based on the ANOVA test, so it would appear as if each subgroup of male, female, White, Black, and Hispanic are benefitting from the program. When it came to the age groups, there were statistically significant differences found between the three age groups in the algebra scores. These results are discussed in more detail in the following paragraphs. There was a very small control group of four students who have not taken any math classes since they took the pretest. Upon taking the retest, their algebra scores did not show any significant statistical increase. There were a small number of students whose algebra scores decreased from pretest to posttest. Further research in this area is suggested in order to determine why their scores dropped. The reasons why the scores dropped are outside the scope of this study.

The scores for males and females were not found to have any statistical difference according to the dependent *t*-tests that were carried out. The scores for males increased by an average of 9.5 points for those in the treatment group ($M_{diff} = 9.5$, $t(87)=4.8$, $p < .0001$, (95% CI): 5.6 – 13.5). The dependent *t*-test for females showed that the developmental math program contributed to increases in scores of 8.8 points on average on the placement test (M_{diff} = 8.8, t(94)=6, p < .0001, (95% CI): 5.8-11.8). While it appears as if the males are gaining 1.7 points more than the females from pretest to posttest, this was not found to be statistically significant. It should be noted here that this is the reverse of what occurred in the arithmetic scores where the females gained two points more than males on average.

In the case of age groups, the ANOVA test did find mean differences in the algebra scores (F(2, 180)=4.87, p=.0087). Further analysis was needed in order to determine where these differences occurred, so pair-wise comparisons were performed using the Scheffe adjustment in order to control for the Type I error rate. According to the data analysis, the 26 to 35 age group gained 11.2 points more on average than those in the 25 and under age group (M_{diff} = 11.2, p < .001). The 26 to 35 age group gained 14.4 points more on average than those in the 36 and over age group their algebra scores (M_{diff} = 14.4, p < .001). It appears as if the 26 to 35 age group gained the most, followed by the 36 and over age group, and then the 25 and under age group. Based on this data analysis, the researcher would make the following recommendations for the program in the algebra portion in the area of age groups. The developmental education department could offer two courses of MAT 070 based on age groups. There would be a course for those in the under 25 age group and a course for those in the 36 and over age group. This would allow the instructors to target each specific age group separately. As it is now, the courses contain a mixture of ages. This seems to work well for those in the 26 to 35 age group. Separating out the other two age groups will allow the instructors to make adjustments to the lessons in order to meet the needs of each age group. After the first semester of doing this, the results from these courses could be examined in order to determine if any improvement occurred. The researcher did not find any relevant research on this subject in the literature review.

Another suggestion would be to conduct further research as to why these two age groups are not making the same gains in algebra scores as those in the 26 to 35 age groups. Since each age group receives the same instruction, the same textbook, the same syllabus, the same amount of instructional time, etc., the reasons for the differences in the scores are not readily apparent. Surveying these students may yield some insights as to why these differences are occurring.

Next the researcher examined data from the different ethnic groups. From the data analysis by dependent *t*-tests, it appears as if the scores of Hispanics increased the most by 15.0 points, followed by Whites with 9.3 points, and then Blacks with 5.6 points. While there are apparent differences in the gains made by each ethnic group, the ANOVA test did not find the differences to be statistically significant in the area of arithmetic scores ($F(3, 179)=0.59$, $p=0.6236$). This may be due to the sample size for each group which may or may not be indicative of the population in general. For example, there were only three students in the Hispanic sample population and 20 in the Black sample population. Based on the data analysis, the researcher is not suggesting that any changes be made to the developmental math program in the area of algebra instruction at this time.

The research on successful programs indicates a need for frequent program evaluations. Since this is the first time that this developmental math program has been evaluated, it is recommended that more frequent evaluations be carried out from now on. This would be easier to do if the college had the facilities to test students using this pretest-posttest method. This would require additional computer labs and additional faculty or staff who are trained to administer the COMPASS® tests. Since the developmental education department also includes reading and English, it is also recommended that these subjects be evaluated on a regular basis. Knowing where the deficiencies, if any, are occurring, and then addressing those deficiencies, is very important in providing a quality program.

Summary

Overall, it appears as if the developmental math program is doing what it was designed to do based on the survey results from all the participants and from the data from the pretests and posttests. There is a desire and a need for more professional development on how to work with underprepared students and on strategic thinking, as indicated by the comments from the developmental math instructors and the college-level math instructors on their surveys. Recommendations on how to provide this professional development are included in this study. Further research is suggested as to why 26% of former developmental math students who went on to take at least one college-level math class felt that they had been misplaced into a developmental math class, and why 26% of former developmental math students felt that the developmental math program had not helped prepare them for college-level math. The majority of students did feel that the program was doing a good job. Overall, it appears as if the developmental math program is helping to improve the scores in arithmetic and algebra. For the arithmetic scores, all subgroups are benefitting equally as well from the program, and no recommendations were made in this area. For the algebra scores, there were differences detected using ANOVA in the gains within the groups. The area where this is most evident is in the age groups of those taking algebra courses. The 26 to 35 age group is making statistically significant gains when compared to the 25 and under age group and the 35 and over age group. The researcher made a couple of recommendations in this area. One recommendation would be to offer some courses based on age groups, and another would be to conduct further research in this area in order to discover what the reasons are for the differences in these gains.

Since this is the first program evaluation to be carried out at the college, it is recommended that program evaluations become a regular part of all the courses taught in developmental education. This is in keeping with what the literature suggests for all successful programs. Now that the first program evaluation has been conducted, it should be easier to follow this template and apply it to the areas of English and reading. Having the evaluations conducted on a rotating basis is recommended. Now that the math program has been evaluated, perhaps the English program could be evaluated next year, followed by the reading program the following year. This pattern would then be repeated so that each program is evaluated on a rotating basis.

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Appendix A

MAT 060 Essential Mathematics Course Description

MAT 060 ESSENTIAL MATHEMATICS

Prerequisites:	MAT 050	Class:	3 hours per week
Co-requisites:	None	Lab:	2 hours per week
		Credit:	4 semester hours

COURSE DESCRIPTION

This course is a comprehensive study of mathematical skills which should provide a strong mathematical foundation to pursue further study. Topics include principles and applications of decimals, fractions, percents, ratio and proportion, order of operations, geometry, measurement, and elements of algebra and statistics. Upon completion, students should be able to perform basic computations and solve relevant, multi-step mathematical problems using technology where appropriate.

COURSE COMPETENCIES

The student should be able to model and solve application problems while learning to:

1. Add, subtract, multiply, and divide fractions and decimals
2. Utilize the correct order of operations
3. Evaluate powers and roots
4. Convert between fractions, decimals, and percents
5. Express ratio and solve proportions
6. Solve percent problems using the percent equation or the proportion method
7. Use unit analysis within the U.S. system and within the metric system
8. Describe and define lines, angles, and basic geometric figures
9. Calculate the perimeter, area, and volume of basic geometric figures
10. Apply the Pythagorean Theorem
11. Add, subtract, multiply, and divide signed numbers
12. Solve simple linear equations in the form ax + b = c
13. Determine mean, median, and mode
14. Interpret basic statistical graphs
15. Use appropriate technology

The above competencies should comprise 80% of the course content. The remaining 20% of the course content may be used for local competencies or for additional instruction/enrichment in the above competencies.

Appendix B

MAT 070 Introductory Algebra Course Description

MAT 070 INTRODUCTORY ALGEBRA

Prerequisites: MAT 060
Co-requisites: RED 080 or ENG 085

Class: 3 hours per week
Lab: 2 hours per week
Credit: 4 semester hours

COURSE DESCRIPTION

This course establishes a foundation in algebraic concepts and problem solving. Topics include signed numbers, exponents, order of operations, simplifying expressions, solving linear equations and inequalities, graphing formulas, polynomials, factoring, and elements of geometry. Upon completion, students should be able to apply the above concepts in problem solving using appropriate technology.

COURSE COMPETENCIES

The student should be able to model and solve application problems while learning to:

1. Add, subtract, multiply, and divide real numbers
2. Apply the laws of integer exponents
3. Simplify and evaluate expressions
4. Translate from verbal into numeric, symbolic and graphic forms
5. Solve linear equations and inequalities (numerically, analytically, and graphically)
6. Graph equations in one and two variables
7. Evaluate and solve literal equations
8. Perform basic operations with polynomials
9. Factor by the greatest common factor
10. Factor $ax^2 + bx + c$
11. Define and describe the relationships among lines, angles, and geometric figures
12. Determine the equation of a line
13. Use appropriate technology

The above competencies should comprise 80% of the course content. The remaining 20% of the course content may be used for local competencies or for additional instruction/enrichment in the above competencies.

Appendix C

MAT 080 Intermediate Algebra Course Description

MAT 080 INTERMEDIATE ALGEBRA

Prerequisites:	MAT 070	Class:	3 hours per week
Co-requisites:	RED 080 or ENG 085	Lab:	2 hours per week
		Credit:	4 semester hours

COURSE DESCRIPTION

This course continues the study of algebraic concepts with emphasis on applications. Topics include factoring; rational expressions; rational exponents; rational, radical, and quadratic equations; systems of equations; inequalities; graphing; functions; variations; complex numbers; and elements of geometry. Upon completion, students should be able to apply the above concepts in problem solving using appropriate technology.

COURSE COMPETENCIES

The student should be able to model and solve application problems while learning to:

1. Factor polynomials
2. Identify, evaluate and simplify rational expressions
3. Define rational exponents and evaluate expressions involving rational exponents
4. Solve rational, radical and polynomial equations (numerically, analytically, and graphically)
5. Solve rational and polynomial inequalities (numerically, analytically, and graphically)
6. Identify and use functions (verbally, numerically, graphically, and symbolically)
7. Solve systems of equations
8. Define and solve direct, inverse and joint variation
9. Perform basic operations with complex numbers
10. Apply topics of analytic geometry including: distance formula, midpoint formula, and slope
11. Use appropriate technology

The above competencies should comprise 80% of the course content. The remaining 20% of the course content may be used for local competencies or for additional instruction/enrichment in the above competencies.

Appendix D

Placement Scores

COMPASS PRE-ALGEBRA (COMPMP) Score	ASSET **NUMERICAL SKILLS** Score	**Accuplacer (CPT)** Arithmetic Score	Course Placement
0-24 (Re-Test Range: 0-24)	**23-29** (Re-Test Range: 23-29)	----------------------	Life Skills Program
25-46 (Re-Test Range: 38-46)	**30-40** (Re-Test Range: 38-40)	----------------------	MAT 060
-----------------------	**41-55**	**55-120**	Places out of MAT 060- Refer to ASSET or Accuplacer Elementary Algebra Score or ASSET Intermediate Algebra Score
47-99	-------------------------	----------------------	MAT 070, 101

Students who have Accuplacer Arithmetic scores below 55 will be required to take the COMPASS Mathematics test unless they have other placement test scores or class credits that can be used to place out of MAT 060.

An ASSET Intermediate Algebra score of 41+ is required to place into MAT 121, 151, 161/161A.

COMPASS ALGEBRA (COMPMA) Score	*ASSET **ELEMENTARY ALGEBRA** Score*	*ASSET **INTERMEDIATE ALGEBRA** Score*	***Accuplacer (CPT)** ELEMENTARY **ALGEBRA Score***	***Course Placement***
0-45 (Re-Test Range: 40-45)	**23-40** (Re-Test Range: 38-40)	**23-34** (Re-Test Range: 32-34)	**0-54**	MAT 070,101
46-65 (Re-Test Range: 56-65)	**41-55**	**35-40** (Re-Test Range: 39-40)	**55-74**	MAT 080,110, 115,120,140
66-99	--------------------	**41-55**	**75-120**	MAT 121,151, 161/161A

COMPASS COLLEGE ALGEBRA (COMPMC) Score	Course Placement
0-64 (Re-Test Range: 56-64)	MAT 121, 151, 161/161A
65-99	MAT 175/175A

COMPASS TRIGONOMETRY (COMPMT) Score	Course Placement
0-64 (Re-Test Range: 53-64)	MAT 175/175A
65-99	MAT 271

Appendix E

Demographic and Survey Questions for Current Developmental Math Students

First Name: ________________________Last Name:______________________

Student ID: ____________________ Age at last birthday: _________

Gender (circle one): Male Female

Ethnicity (circle one): Caucasian/White African American/Black Hispanic

Asian/Pacific Islander Alaskan/Native American Other Prefer not to respond

1. Which math class are you currently taking at the college?
   -MAT 060
   -MAT 070
   -MAT 080
   -I am currently not taking a math class.

2. Is your current math class a:
   -Day class (starts before 5:30 p.m.)
   -Evening class (starts on or after 5:30 p.m.)
   -Hybrid Class (a combination of online and in-class work)
   -Online Class
   -I am not currently taking a math class.

3. Which answer describes your current math instructor?
   -Full-time
   -Part-time
   -Not sure

Please respond to the following statements by circling the number that best describes how you feel.

1 = Strongly Disagree
2 = Disagree
3 = No Opinion
4 = Agree
5 = Strongly Agree

4. The placement test put me in the correct math class.

   1 2 3 4 5

5 The developmental math program is doing an adequate job of preparing me for college-level math.

1 2 3 4 5

6 I believe that the developmental math program is doing a good job overall.

1 2 3 4 5

Appendix F

Survey of Former Developmental Math Students

First Name: ________________________Last Name:______________________

Student ID: ____________________   Age at last birthday ________

Gender (circle one):   Male   Female

Ethnicity (circle one):   Caucasian/White   African American/Black   Hispanic

Asian/Pacific Islander   Alaskan/Native American   Other   Prefer not to respond

Note:
A Day class starts before 5:30 p.m.
An Evening class starts on or after 5:30 p.m.
A Hybrid Class is any combination of online and in-class work
An Online Class is any class taught via the Internet

1. Which developmental math class or classes did you take at this college? Circle **ALL** that apply.

   - MAT 060   day class   evening class   hybrid class   online class

   - MAT 070   day class   evening class   hybrid class   online class

   - MAT 080   day class   evening class   hybrid class   online class

   - I did not take a developmental math class ______

Please respond to the following statements by circling the number that best describes how you feel.

1 = Strongly Disagree
2 = Disagree
3 = No Opinion
4 = Agree
5 = Strongly Agree

2. The placement test put me in the correct math class.

1   2   3   4   5

3. The developmental math class(es) that I took did an adequate job of preparing me for college-level math.

1   2   3   4   5

4. I believe that the developmental math program is doing a good job overall.

1 2 3 4 5

Appendix G

Interview Guide for the Developmental Math Instructors

Individual Instructor Code: _____

1. Please list all degrees, certificates, and other qualifications that relate to your current teaching position.

2. How long have you been teaching?

3. How long have you been teaching in the developmental math program?

4. How much training (if any) have you received in the developmental math program?

5. What did this training consist of?

6. Why do you think that there is a developmental program at the college?

7. What do you believe the developmental math program is designed to do?

8. Do you think the program is doing what it is designed to do?

9. What other attempts have been made in the past in order to meet the needs of students who needed help in math?

10. How is teaching developmental math different from teaching college-level math? Explain.

11. How do you think that the developmental math program could be improved? (Feel free to discuss placement tests, hybrid classes, class size, final exams, textbooks, computer software, or anything that has to do with the developmental math program).

12. Please add any additional comments that you think would contribute to this study of the developmental math program

Please respond to the following statements by indicating the number that best describes how you feel.

1 = Strongly Disagree
2 = Disagree
3 = No Opinion
4 = Agree
5 = Strongly Agree

13. I believe that the placement test places students into the correct math class. Explain.

1 2 3 4 5

14. I believe that the developmental math program is doing an adequate job of preparing students for college-level math classes. Explain.

1 2 3 4 5

15. I believe that the developmental math program is doing a good job overall.

1 2 3 4 5

16. Please check all that apply on the sheet titled Appendix I.

Appendix H

Interview Guide for College-level Math Instructors

Individual Instructor Code: _____

1. Please list all degrees, certificates, and other qualifications that relate to your current teaching position.

2. How long have you been teaching?

3. Why do you think that there is a developmental program at the college?

4. What do you believe that the developmental math program is designed to do?

5. Do you think that the program is doing what it is designed to do?

6. What other attempts have been made in the past in order to meet the needs of students who needed help in math?

7. How is teaching developmental math different form teaching college-level math? Explain.

8. How do you think that the developmental math program could be improved? (Feel free to discuss placement tests, hybrid classes, class size, final exams, textbooks, computer software, or anything that has to do with the developmental math program).

Please respond to the following statements by indicating the number that best describes how you feel.

1 = Strongly Disagree
2 = Disagree
3 = No Opinion
4 = Agree
5 = Strongly Agree

17. I believe that the placement test places students into the correct math class. Explain.

1 2 3 4 5

18. I believe that the developmental math program is doing an adequate job of preparing students for college-level math classes. Explain.

1 2 3 4 5

19. I believe that the developmental math program is doing a good job overall.

    1 2 3 4 5

20. Please check all that apply on the sheet titled Appendix I.

    Please add any additional comments that you think would contribute to this study of the developmental math program.

Appendix I

Checklist of 20 Items for Successful Programs

List of 20 Items that Appear to Contribute to Successful Programs

As Compiled By Hunter R. Boylan & D. Patrick Saxon

National Center for Developmental Education

Check one

College-level Instructor ____________

Developmental Instructor ___________

Please respond to the following statements by indicating the number that best describes your answer to each question

1 = Strongly Disagree
2 = Disagree
3 = No Opinion
4 = Agree
5 = Strongly Agree

1. There are clearly established goals and objectives for developmental math courses.				
1	2	3	4	5
2. Mastery learning techniques are used in developmental math courses, i.e., students do not move on to another topic until they have mastered the current topic.				
1	2	3	4	5
3. There is a high degree of structure in developmental math courses.				
1	2	3	4	5
4. A variety of approaches and teaching methods are used in developmental math instruction.				
1	2	3	4	5
5. There is sound cognitive theory in the design and delivery of developmental math courses.				
1	2	3	4	5
6. A centralized and coordinated developmental math program is in place.				
1	2	3	4	5

7. Formative evaluation is used to guide program development and improvement. 1 2 3 4 5
8. There is a strong philosophy of learning in place in order to deliver program services. 1 2 3 4 5
9. Mandatory placement testing is in place. 1 2 3 4 5
10. A counseling component is integrated into the structure of developmental education. 1 2 3 4 5
11. Tutoring is performed by trained tutors. 1 2 3 4 5
12. The classroom and laboratory activities are integrated. 1 2 3 4 5
13. There is an established college-wide commitment to developmental education. 1 2 3 4 5
14. Consistency exists between exit standards for developmental math courses and entry standards for the college-level math courses. 1 2 3 4 5
15. Learning communities are used in developmental instruction. 1 2 3 4 5
16. The use of Supplemental Instruction, such as video-based and/or computer-based Supplemental Instruction to support developmental courses. 1 2 3 4 5
17. There are workshops provided on strategic thinking. 1 2 3 4 5

18. There is specific professional development provided on how to work with underprepared students.				
1	2	3	4	5
19. There are ongoing student orientation courses.				
1	2	3	4	5
20. Critical thinking is integrated into the developmental math curriculum.				
1	2	3	4	5

Appendix J

Consent Form

Program Evaluation of Developmental Math Instruction at the Community College Level
By John McHugh

I am conducting a study about the developmental math program at the community college level. I invite you to participate in this research. You were selected as a possible participant because you are taking, or have taken, a developmental math class. Please read this form and ask any questions you may have before agreeing to be a part of this study.

This study is being conducted by: John McHugh, Chair of Developmental Education.

Background Information:
The purpose of this study is to evaluate the developmental math program at the community college level. This study will aid the college in making decisions about the program

Procedures:
If you agree to be in this study, I will ask you to do the following things: You will take a math test on the computer in the computer lab. This test will be similar to the placement test that you took when you first applied to the college. At the beginning of the test, there will be approximately 16 survey questions. The survey questions are also part of the study. The survey and math test should last approximately 30 minutes.

Risks and Benefits of Being in the Study:
The study has no risks to you.
The direct benefit you will receive for participating is that recommendations for improvements will be made to the developmental math department based on the results of this study.

Compensation:
You will not receive any compensation for being part of this study.

Confidentiality:
The records of this study will be kept confidential. In any sort of report I publish, I will not include information that will make it possible to identify you in any way. The items will be kept under lock and key, and shredded at the end of this study.

Voluntary Nature of the Study:

Your participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your current or future relations with anyone at the college. If you decide to participate, you are free to withdraw at any time up to and until ***May 31st, 2010***, without penalty. Should you decide to withdraw data collected about you, please notify Mr. McHugh and he will take care of that for you.

Contacts and Questions

My name is John McHugh. You may ask any questions you have now. If you have questions later, you may contact me at 704-861-8926, or by email at jmchugh@gaston.edu. You may also contact Gardner-Webb University's Institutional Review Board at 704-406-4000, ext. 4402 with any questions or concerns.

You will be given a copy of this form to keep for your records.

Statement of Consent:

I have read the above information. My questions have been answered to my satisfaction. I consent to participate in the study. I am at least 18 years of age.

______________________________ ________________
Signature of Study Participant **Date**

____
Print Your Name Here

______________________________ ________________
Signature of Researcher **Date**

Appendix K

Debriefing Form

DEBRIEFING FORM

Program Evaluation of Developmental Math Instruction at the Community College Level

PURPOSE

The purpose of the study is to evaluate the overall effectiveness of the Developmental Math Program at ________________ College.

BACKGROUND

Researchers in the field of Developmental Education have stressed the need to conduct a program evaluation as a way to improve the overall effectiveness of each program. The information that you provide will be used to assist the researcher in evaluating the developmental math program at _____________ College.

CONFIDENTIALITY

Your confidentiality is assured. Your name will not appear on any report whatsoever at any time. Your scores and the information you provide will have no effect on any grade or any decisions that are made in relation to your performance in any class. After the study has been completed, all of your scores and information will be shredded. If you wish to withdraw your scores or information at any time, please contact John McHugh at 704-922-6237, or by email at jmchugh@gaston.edu

FINAL REPORT

If you are interested in obtaining a copy of the final report of this study, contact the researcher, John McHugh at 704-922-6237, or by email at jmchugh@gaston.edu

CONTACT

If you have *any* questions regarding this study, its purpose or procedures, please feel free to contact the researcher, John McHugh at 704-922-6237, or by email at jmchugh@gaston.edu

Appendix L

Interview Guide for Instructors Who Set Up Program

Research Questions for the Instructors Who Were Involved in
Setting Up the Program.

1. When did the program begin?
2. Why did the program begin?
3. What were the needs of the students at that time?
4. What options did the students have available to them prior to this?
5. What other attempts had been made in order to meet the needs of those students who needed help in math?
6. What was the goal of the program?
7. Who was involved in setting up the program?
8. How was the program set up?
9. Was it modeled on any other programs?
10. Do you have any documentation that relates to the setting up of the program, or do you know if any exists?
11. Is there any other historical information that you would be willing to contribute to this study? Please elaborate.

Appendix M

Sample Course Evaluation Form

Overall Ratings

1. Overall, my knowledge/skills increased significantly in this subject.
2. Overall, the instructor did an effective job in teaching/facilitating this course.
3. Overall, I would recommend this instructor to other students.

Course Organization & Content Ratings

4. Objectives were clearly outlined in the course overview or course syllabus.
5. Course content aligned with the objectives.
6. Required materials (books, software, reading, etc.) related to the course.
7. Assignments/activities were clear and supported course objectives.
8. Exams and/or graded materials related to the course objectives.
9. Course was presented in a way that helped me learn and understand the materials.

Instructor Ratings

The Instructor:

10. Demonstrated knowledge of this course's subject matter.
11. Provided useful and meaningful teaching methods/materials.
12. Was available personally and/or electronically.
13. Provided a clear grading system.
14. Kept me informed about my progress (returned tests, papers, feedbacks, etc. within reasonable amount of time).
15. Encouraged an atmosphere for participation and learning.
16. Demonstrated an interest in my success as a student.

Comment Section (optional)

What was effective in your learning experience?

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What could have improved your learning experience?

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Appendix N

Approval Letter from D. Patrick Saxton

Appalachian State University

National Center for Developmental Education
ASU Box 32098
Boone, NC 28608-2098
(828) 262-3057
Fax: (828) 262-7183
www.ncde.appstate.edu

November 8, 2010

John McHugh
Gaston College
Box 131 Highway 321 South
Dallas, NC 28034

Dear Mr. McHugh,

I have reviewed your request to use the survey based on the information from the book *What Works: Research-Based Practices in Developmental Education* in your doctoral dissertation. The National Center for Developmental Education grants permission for you to use the criteria from this book as long as the following conditions are met:

- **the information source is cited on the survey documents, and**
- **the information is used by a graduate student solely for research and scholarly activities.**

Good luck with your research. If you have questions, please contact me.

Sincerely,

D. Patrick Saxon
Assistant Director